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the Course of OIL

An Unnecessary Government Expenditure

Is the construction of commercial plants for the production of liquid fuel from oil shale or coal justified on economic grounds at this time? Evidently not, for no private company is yet willing to undertake their construction and operation without a guarantee of some kind from the government. Oil industry authorities in 1948 produced convincing evidence before a Congressional committee that left no doubt on this point. Today, three years later, when the country is getting into high gear on its defense program, and steel supplies are at a premium and government expenditures climbing, there is even less justification on any grounds for the erection of these plants at this time. Coal and oil shale would consume more steel than petroleum per barrel of liquid fuel produced. As commercial ventures the plants could not be operated successfully. Yet Secretary of the Interior Chapman appears bent on earmarking $455,000,000 of government funds to be used to guarantee price supports for liquid fuel and other products from coal and oil shale. He has recommended to the Defense Production Administration that this amount be allocated in support of coal hydrogenation and oil shale plants proposed to be built by private capital.

The main supporting thesis for building these plants is the possibility of domestic oil reserves being insufficient to supply the country's future needs, that we may be running out of oil—what a fallacy on which to justify a subsidy such as the Secretary recommends. When we have reached the zenith of domestic production it can be safely assumed that those companies engaged in the production of oil and refined products will have recognized well in advance the need for developing production from other raw materials such as coal and oil shale. To assume otherwise is to deny the virility of the oil industry, which at no time has failed to increase oil and its products when critically needed, or to find and develop new reserves well in advance of future needs.

The oil industry is in full sympathy with, and encourages a government program of research and development on the production of liquid fuel from coal and oil shale. Some oil companies have spent and are spending large sums of their own money investigating the possibilities of oil production from shale and liquid fuel from coal. The country can rest assured that when it becomes commercially feasible to do so the oil companies will be among the first to engage in the manufacture of liquid fuels from coal and oil shale—and without government subsidy.

The National Petroleum Council is now compiling and analyzing information on synthetic fuels. Their findings should be available soon. It will not be surprising if the facts disclosed are a deterrent to sanctioning a government subsidy for the purpose recommended by the Secretary of the Interior. As was once so aptly stated, justification for building these plants should be based on sound economics, not subsidies. This statement still holds, even in the present national emergency.—K. C. S.

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With The EDITORS . . . .

Petroleum from Marine Life

PETROLEUM was synthesized during past geologic aeons from unsaturated "fatty oils of marine origin," says chemical consultant Benjamin T. Brooks to the Petroleum Division of the American Chemical Society in its New York City meeting extraordinary this month. And because of the relatively low temperatures, which geologists agree prevailed in prehistoric time in strata in which petroleum was produced, the aid of catalysts is considered to be indispensable to the accomplishment of this metamorphosis.

Fortunately for this theory, materials of known and proved catalytic effect were always present in the earth's crust strata. Silicate minerals such as clays, limestone, and quartz sand all show catalytic activity in varying degrees, even at the relatively low temperatures accredited to exist during these long ages. And to these variations in catalytic effects are attributed the wide variations in the composition of different petroleum crudes. Concensus is also that pressure has not been and need not be a factor in petroleum synthesis under natural conditions. It is believed also that the fatty oils were unsaturated originally, facilitating their reaction under the probably mild conditions under which the proposed reaction took place. Chemical reactions of carbonium ions, the Whitmore theory explaining polymerization, alkylation and isomerization reactions are considered to be a part of the picture. It has been proved that pressure-temperature conditions known to exist during petroleum formation were such that no such reactions would occur to any appreciable extent.

The carbonium ion reaction is probably the primary factor in petroleum synthesis. This system offers the first creditable explanation of the formation of aromatics in earth strata. The reactions of acyclic unsaturate organic materials via the carbonium ion route indicates an explanation of the formation of cyclo-paraffins in petroleum, possibly an intermediate step toward aromatics, reached eventually in the synthesis by catalytic dehydrogenation of the saturated cyclic molecules. The high stability of hydrocarbons at the temperatures believed to obtain in nature in past ages, 100 to 250 F, demands a catalyst to effect reactions of these types.

Molecular structure changes such as produce the "maturing" of "young" petroleums have been shown not to occur at the low temperatures involved, McNab, Smith, and Betts of Esso Laboratories find by studying the hydrocarbon material from oil sands. At 150 F they believe cracking or hydrocracking occur to crude oils in rock formations. Crudes produced from rocks of different ages by their differences in composition show that they have reached different stages in their progress toward what may be termed "maturity". The theories expressed in these papers appear to supersede those advanced formerly, claiming origin from vegetable or even mineral sources such as the metal carbide theory. More creditable support for the new theories is traceable mainly to our recent advances in the science of catalysis and to the carbonium ion theory.

—A. L. F.

Transportation Study

UNDER supervision of the Petroleum Administration for Defense, a special group of consultants is making the first comprehensive survey of petroleum transportation in the United States. The study, which has been underway more than six months, will cover existing facilities for the movement of petroleum and its products by pipe line, tanker, barge, tank car, and tank trucks. Furthermore, the expected volume of oil to be moved through 1955 will be indicated.

It has been pointed out by Secretary of the Interior Oscar L. Chapman that, although relatively complete data exist on oil production, refinery capacity, and demand, similar information on transportation has been unavailable.

Results of the study are intended for use by PAD to aid in determining future requirements of the petroleum industry for transportation facilities. Results of this survey, expected soon, are awaited with interest because they will give some indication also of the possible growth of the pipe line industry during the next several years.—F. H. L.

Gas Line Forecast

ENCOURAGEMENT can be taken from the recently announced report of the American Gas Association's Bureau of Statistics, in which it was revealed that the gas industry will spend a total of $4.59 billion dollars for construction in the next five years. Of particular interest and importance to the pipe line industry is the fact that for gas transmission lines alone these expenditures are forecast: For 1951. $994,800,000; 1952, $773,000,000; 1953, $295,400.-000; 1954, $185,800,000, and 1955, $146,800,000.

Uncertainties in world conditions and the material supply situation make a long-time forecast difficult and this is admitted by those making the report. It is stated frankly that the indicated expenditures pertaining to the later years may be understated. Actually, it is more than likely that they are, because the current figures for 1953 and 1954, for example, are double those projected for these years only 12 months ago.—F. H. L.

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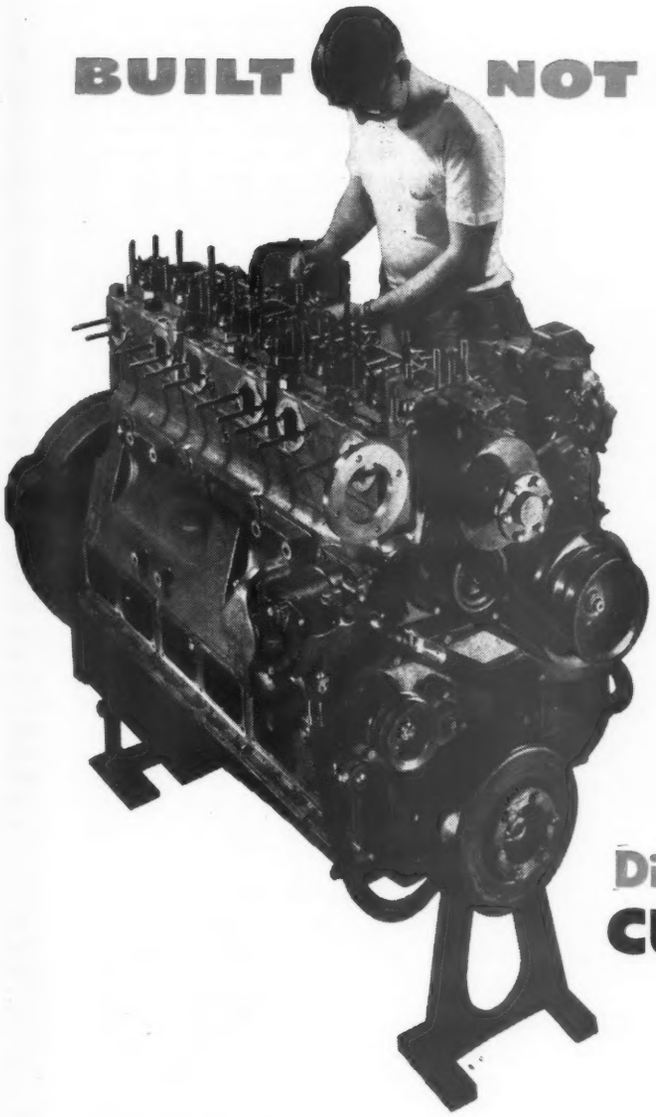

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HIGHLIGHTS IN OILDOM

IRAN ADVERTISES OIL

Iran will sell its Abadan oil refinery products to anyone who can provide a tanker, an advertisement in a British newspaper revealed recently. The ad, which ran in the "Daily Herald," official organ of the labor party, and mouthpiece of the British Socialist government, stated: "The National Oil Company of Iran is prepared to sell crude oil and oil products, FOB, Abadan or Bandar Mashur."

Payments are to be made either against the opening of credits and documents in the name of the National Oil Company of Iran, at an approved bank in Iran, or against drafts in dollars, transferable to pounds sterling, Swiss francs, or Indian rupeees. At the bottom of the ad were these words, "Tankers to be provided by buyers."

STEEL CUTBACKS CRITICIZED

Protests are mounting against the manner in which the Petroleum Administration for Defense is handling allocation of steel to the petroleum industry. The Texas Independent Producers and Royalty Owners Association, headed by E. I. Thompson, voiced a protest in the form of a letter to Bruce K. Brown, deputy administrator, with copies going to Secretary Chapman and Richard G. Lawton, production director of PAD.

Thompson said there are a number of independent operators with critical drilling obligations who received little or no allocations of pipe for the third and fourth quarters and as a result are being forced to farm out or sell their properties. Thompson declared that many of these operators "are in open revolt and are advocating scrapping the whole PAD program."

GROUP SEEKS OIL TITLE

A private group is using a "fantastic plan" to take over offshore Louisiana oil wells by using public land scrip issued years ago to old soldiers, Representative Willis of Louisiana has charged. He urged Secretary Chapman to deny the land applications of the group, which he claims is headed by E. L. Cord, former automobile manufacturer. The land scrip, Willis stated, was issued by Congress after some of the Indian wars, the War of 1812, and the Civil War.

The scrip certificate entitles soldier to whom it was issued or his heirs and assigns to claim a tract of public land, usually 160 acres. Willis said the Cord group is actually seeking title to 40 oil wells off the coast of Louisiana, producing 12,000 bbl of oil daily, all the producing wells in the area.

OIL ESTIMATES HIGH

By 1955 the U. S. can boost its crude oil output by about 1,200,000 bbl a day, the Petroleum Administration for Defense estimates. The PAD estimate was based on the assumption that drilling can and will be continued at about the 1951 rate, and that about 43,000 wells will be completed annually over the next five years. If this estimate holds true, crude oil production capacity can be increased from about 6,800,000 bbl a day to 8,000,000 bbl a day in 1955.

PAD REVISES STEEL LAW

A new order has been released that will allow steel producers to pick and choose among the controlled materials orders they receive, regardless of the date of receipt, until 15 days before the expiration of established lead times for their products. Working under the National Production Authority's Controlled Materials Plan, mills have heretofore been required to accept all orders on a first-come-first-serve basis.

The new order will permit steel producers to accept or reject orders as they see fit until 15 days before the expiration of lead time set for individual steel products. A lead time is the number of days before the first day of the month in which delivery is requested that a user must file an order with a mill.

EUROPEAN RESEARCH LAB

Battelle Memorial Institute has announced plans to establish a European branch of its laboratories to serve the European economy. According to Battelle Director Clyde Williams, the decision follows a recently completed survey of scientific and industrial conditions in Europe. Research authorities, which included Dr. Harold Vagtborg, president of Southwest Research Institute, made an exhaustive survey of West Germany's scientific research resources under ECA sponsorship recently. Primary objective of the survey was to determine the need for applied research institutes in West Germany for national security.

SYNTHETIC FUELS PLANT

Secretary of the Interior Oscar L. Chapman has asked the U. S. treasury to set-aside $445 million to take care of any drops in prices below those in effect during February 1951 for chemicals and fuels produced from a proposed coal-hydrogenation synthetic fuels and chemicals plant. The new plant would be built by Ferdinand Eberstadt, New York investment head, and one or two oil shale plants. At the present time the syndicate is trying to get a minimum 11-year government contract.

OIL SHORTAGE MADE UP

Supplies of crude oil already on hand for the United States and Canada are going to Europe to make up for the break in Iranian production. Bruce K. Brown, deputy petroleum administrator has announced that a number of U. S. companies are making arrangements to increase Middle East and Caribbean crude oil production by about 230,000 bbl a day. In addition to that, Brown stated, about 200,000 bbl a day of Middle East crude oil that normally goes to the U. S. and Canada are being sent to Europe.

OIL IMPORTS HIT NEW LOW

During the week ending August 11, crude oil imports reached the lowest level they had hit since August 26, 1950. Imports totaled 643,000 bbl, and 815,300 bbl for the week ended August 4. One year ago the total was 832,700 bbl. Declines in both crude and residual fuel oil imports contributed to the lowered imports. Crude shipments to this country were 473,200 bbl compared with 778,500 bbl in the preceding week. Imports of residual fuel oil were 154,900 bbl, compared with 214,400 in the preceding week, the smallest for more than a year. One reason for the lower imports was given as the rerouting of international petroleum shipments to offset the Iranian loss.

PETROLEUM BASE FIBERS

Limited quantities of wrinkle-proof and shrink-proof men's suits made from petroleum have reached American stores. The fiber of the material has petroleum derivatives for both its ingredients. One of them is ethylene glycol, which for years was used for a permanent automobile anti-freeze. To test the suit a man last summer wore one for 67 days, during which time he went for a swim in a pool twice and had the suit laundered once in a washing machine. The suit neither shrank nor stretched nor lost its crease.

RECORD OIL OUTPUT SET

For the first time in the history of the state, Texas will produce more than 3,000,000 bbl of crude oil per day this month. The oil allowable has been set by the Texas Railroad Commission at 3,059,367 bbl, up 76,861 from the previous record of 2,982,506 bbl on August 11.

Testifying before the Railroad Commission group, three Petroleum Administration for Defense officials declared that the extra production in Texas was needed to fill the deficit left by the shutdown of the Abadan refinery in Iran.

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National Petroleum Situation

By H. J. Struth*

SOARING STOCKS. Stocks of crude and products have increased nearly 50,000,000 bbl in the last four months. Estimates place stocks of all oils on July 31, at 606,928,000 bbl, against 568,367,000 bbl a year ago. Seasonal stock accumulations will continue through October, when the winter fuel oil demand will effect substantial withdrawals from inventories. While stock accumulations have exceeded normal seasonal requirements thus far, it is believed that the shift in world supply sources, particularly in the light of the Iranian situation, may alleviate an otherwise unfavorable domestic supply outlook.

FUEL SUPPLY PLENTIFUL. Accumulations of fuel oil stocks have eliminated any fear of a shortage next winter. Fuel oil stocks on July 31 aggregated 125,450,000 bbl, against 104,720,000 bbl a year ago. Stocks now represent 55 days supply, against only 40 days supply a year ago. Fuel oil production in the first seven months of this year was 21 per cent greater than last year, while imports have increased about 10 per cent above last year. In the light of expected stock accumulations between August 1 and November 1, there is ample assurance of an adequate fuel oil supply this winter.

DEMAND UP 13 PER CENT. Demand for all oils in the first seven months of this year was 13 per cent greater than last year. Daily average demand was about 7,410,000 bbl, against 6,561,000 bbl last year. Demand increases this year have been as follows: Motor fuel up 12 per cent; kerosine up 9 per cent; fuel oil up 11 per cent; lube oils up 21 per cent. Meanwhile, the demand for crude oil has shown an increase over last year of 17 per cent, while the crude oil supply has increased 18 per cent.

LESS DEVELOPMENT DRILLING. Well completions in established fields during the first seven months of this year have shown a decline under last year of 4 per cent. Oil well completions were 7 per cent lower, while gas well completions were off 4 per cent. Meanwhile, the number of dry holes drilled in development increased 7 per cent over last year. Continued difficulty experienced by operators in securing steel products is preventing the fulfillment of this year's drilling program. While wildcat operations are up 27 per cent over last year, all drilling operations have increased only one per cent.

*Petroleum Consultant, Dallas, Texas.

Comparative Statistics, July, 1951

*All figures are computed on a Bureau of Mines' Basis**

	July 1951Ⓟ	June 1951Ⓡ	July 1950	This Year to dateⓅ	Last Year to date	Per cent change
Total supply, all oils	234,786	228,111	209,995	1,595,592	1,356,229	+17
Daily average	7,574	7,603	6,774	7,526	6,397	
Total demand‡, all oils	222,940	219,962	200,623	1,571,098	1,390,981	+13
Daily average	7,191	7,332	6,472	7,410	6,561	
Change in stocks	+11,846	+ 8,149	+ 9,372	+24,494	−34,752	
Crude supply*	209,000	202,905	185,093	1,398,657	1,182,894	+18
Daily average	6,742	6,763	6,000	6,600	5,580	
Crude demand‡	205,615	202,508	187,110	1,394,920	1,195,980	+17
Daily average	6,632	6,750	6,036	6,580	5,641	
Crude stocks	252,200	248,815	240,270	252,200	240,270	+ 5
Days supply	38	37	40	38	40	
Natural gasoline production	17,980	17,500	14,985	119,523	100,701	+18
Daily average	580	583	483	564	475	
Motor fuel production	99,900	95,900	91,017	651,192	575,015	+13
Daily average	3,222	3,196	2,936	3,071	2,712	
Gasoline yield per cent	43.5	43.3	44.3	42.6	43.6	−1.0
Motor fuel demand‡	103,850	102,069	93,699	644,672	573,944	+12
Daily average	3,350	3,402	3,022	3,040	2,707	
Motor fuel stocks	122,900	126,800	111,499	122,900	111,499	+10
Days supply	37	37	36	37	36	
Fuel oil production	78,170	74,300	67,591	549,198	451,727	+21
Daily average	2,521	2,476	2,180	2,600	2,130	
Fuel oil demand‡	70,095	68,240	66,131	614,648	553,972	+11
Daily average	2,261	2,274	2,133	2,900	2,613	
Fuel oil stocks	125,450	109,500	104,720	125,450	104,720	+20
Days supply	55	48	49	55	40	
Refinery still runs	201,300	197,100	182,330	1,367,647	1,163,631	+17
Daily average	6,493	6,570	5,882	6,451	5,490	
Stocks, all oil	606,928	595,082	568,367	606,928	568,367	+ 7
Days supply	84	81	88	84	88	

Current Crude Oil Prices

U. S. average	$2.58	Louisiana	$2.62	**Basic crude prices:**	
Texas	2.61	Arkansas	2.43	Oklahoma-Kansas (36 gr.)	$2.57
California	2.42	New Mexico	2.40	Texas Gulf Coast (36 gr.)	2.80
Oklahoma	2.62	Mississippi	2.23	East Texas	2.65
Kansas	2.62	Illinois	2.76	West Texas (36 gr.)	2.44
		Other states	2.60	California Signal Hill (26 gr.)	2.31
				Pennsylvania, Bradford	4.25

Drilling and Production Statistics

	July 1951Ⓟ	June 1951Ⓡ	July 1950	This Year to dateⓅ	Last Year to date	Per cent change
Wells Drilling	5,315	5,355	5,220	5,315	5,220	+ 2
Total wells drilled	3,833	3,674	3,941	23,975	23,631	+ 1
Development wells	2,852	2,780	3,130	18,122	18,853	− 4
Oil	1,859	1,823	2,092	12,022	12,926	− 7
Gas	221	211	240	1,391	1,451	− 4
Dry	772	746	798	4,709	4,476	+ 7
Per cent dry	27.0	26.8	25.5	26.0	23.7	+ 2.3
Service wells	64	50	76	366	447	−17
Wildcat wells	917	844	735	5,487	4,331	+27
Oil	134	142	112	897	658	+36
Gas	21	21	12	158	124	+27
Dry	762	681	611	4,432	3,549	+25
Per cent dry	83.0	81.0	83.1	81.0	81.9	− 0.9
By State						
Wells drilled (excl service)	3,769	3,624	3,865	23,609	23,184	+ 2
Arkansas	31	37	40	222	230	− 3
California	216	206	183	1,255	1,020	+23
Illinois	249	236	312	1,182	1,523	−22
Kansas	347	370	337	2,469	2,067	+19
Louisiana	185	189	217	1,181	1,389	−14
Mississippi	41	34	20	186	187	− 1
New Mexico	72	51	33	379	351	+ 8
Oklahoma	458	411	517	3,151	3,051	+ 3
Texas	1,455	1,415	1,489	9,552	9,362	+ 2
Other states	715	675	717	4,032	4,004	0
Wildcats drilled	917	844	735	5,487	4,331	+27
Arkansas	8	7	12	53	64	−17
California	55	41	44	283	228	+24
Illinois	78	72	67	321	367	−13
Kansas	102	107	63	637	399	+59
Louisiana	32	22	27	180	155	+16
Mississippi	13	12	9	75	78	− 4
New Mexico	12	7	4	63	42	+50
Oklahoma	74	68	75	553	493	+12
Texas	374	364	306	2,422	1,840	+32
Other states	169	144	128	900	665	+36
Daily crude production	6,177	6,191	5,484	6,080	5,107	+19
Arkansas	80	79	85	81	85	− 4
California	979	963	882	965	869	+11
Illinois	169	172	166	164	170	− 3
Kansas	311	313	313	311	290	+ 7
Louisiana	637	649	586	636	553	+15
Mississippi	103	102	109	102	102	0
New Mexico	150	144	131	142	129	+10
Oklahoma	532	519	462	511	424	+21
Texas	2,780	2,779	2,332	2,709	2,076	+31
Wyoming	192	187	162	190	158	+20
Other states	244	284	256	269	251	+ 7

* Unless otherwise stated all figures represent thousands of barrels. ‡ Total demand, including exports. * Includes domestic production and imports. Ⓟ Preliminary. Ⓡ Revised.
Preliminary estimates based upon data supplied by American Petroleum Institute, U. S. Bureau of Mines, State Agencies, and other official sources.

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PETROLIC PERSONALITIES

DICK SNEDDON

A Sea-Going Equestrian

While playing with the dials on the television set a few Sundays ago we heard a familiar voice discoursing on the matter of fractional equines or quarter horses as they are sometimes known. We tuned in the station a bit more accurately and there, large as life, was Elmer Decker explaining the various events at the Long Beach horse show to all who cared to look and listen. We bent an attentive ear and eye to these exercises for a while and were instructed and entertained no end. We had noted some time prior to this that the weight indicator baron and erstwhile Nomad prexy was scudding about the seven seas in a saucy craft, named the *Alician*, owned and piloted by another well known oil man, Lester Callahan. They were bound for Guaymas and Mazatlan waters where with the aid of an accompanying coterie of big game fishermen they hoped to reduce the piscatorial population to something like sensible proportions. It had been planned that Mrs. Decker and other ladies interested in the welfare of the gallant little group would fly to Mazatlan and join the festivities at a later date.

Varsity Golfer Takes to Gin Rummy

From out the wilds of Michigan comes our Chicago operative, Perk Perkins, fabricator of soothing decibels, singing the praises of a progressive Lansing institution and the energetic and ingenious chap who guides its destiny. We speak, naturally, of the Mahoney Contracting Company and Ed Mahoney from whom the organization acquired its hibernian moniker. Ed is a graduate chemical engineer from Michigan State College in Lansing, and during his college years was a very sharp golfer, playing on the varsity team in two successive terms and giving a very good account of himself. He admits, however, that his almost exclusive interest in pipe line work during recent times has wrecked his stance and swing and he now trenches much better with a machine than an eight iron.

The result of all this is that he has turned for diversion to a much less strenuous pursuit, gin rummy, in which the left elbow can be bent with impunity. There are those, of course, who think that even in this game too much elbow bending can lead to trouble but that has nothing to do with the case. From the mixed reports that have seeped in so far, it appears that he is both a toughie and a soft touch in the gin rummy racket, depending altogether on whether the reporter was a loser or a winner in his last encounter with the Mahoney scion.

What's a Crossing to a Mahoney

Ed is also something of a nimrod and has a fine set of shooting irons with which to confound anything from a ptarmigan to a ptiger. He plans a trip into the Canadian hinterland this fall and fully expects to get his limit of caribou, elk, and moose. We understand that the way to distinguish these animals from each other is that an elk always has a tooth on his watch chain, the moose has a scnozzola that is an obvious infringement of the Durante patent, and the caribou is the one that is left over. Returning to the business aspects of the Mahoney legend, Ed was 12 years vice president and operations manager for H. L. Gentry Company of Jackson, Michigan, after which he served for a time as gas engineer for the Michigan Gas Commissioner at Lansing.

Later he organized his own contracting business in Mt. Pleasant and in early 1951 moved his headquarters to Lansing. In the meantime, his projects have kept him traveling almost constantly in world wide areas. The firm is at the moment engaged in a contract for Shell Caribbean in Venezuela. This one is a line that crosses Lake Maracaibo a couple of times and also goes over the Gulf of Coral wherever that is. But what is a crossing more or less to a Mahoney! Ed's administrative yen is attested by his recent election to the executive board of the Pipe Line Contractors Association, and his unflinching honesty is also attested by the fact that the board elected him treasurer although he is the only member who was born north of the Mason-Dixon Line.

Tenth Floor Geology

Had a brief session out in Brea, California, with Russ McIntire, Baker Oil Tool's New York export manager while we were both attending a famous whingding, know as Woody's Barbecue. Russ is an Oklahoma lad who came to California in 1917 and did right well for himself by attending to his knitting. He began his career with Belridge Oil Company and stayed there for 16 years before switching to Baker Oil Tools as a service engineer at Taft. He received his present appointment in 1946 and in the meantime has become a confirmed New Yorker. He is at present sergeant-at-arms of New York chapter Nomads and his favorite diversion is a game that has a faint resemblance to golf. He uses the same tools as most golfers but the results are quite different.

Speaking of Belridge reminds us of an adventure that befell Frank Hill when he was director of production for Union Oil Company. He was once obliged to dictate a report to a girl who was quite unfamiliar with petrolic jargon, because his regular secretary was off on a vacation. Speaking of a Belridge try which had been something of a dud, he said, "Perhaps the greatest disappointment that Union Oil Company has experienced in the past six months was the encroachment of edge water into the principal member of the Temblor." What the girl eventually came up with was "Perhaps the greatest disappointment that Union Oil Company has experienced in the past six months was the encroachment of water into the principal members on the tenth floor."

From Argentina to Iran

William J. "Jack" Chancellor came back some time ago from Argentina where he had just put in close to three years for Drillex and expected to go over to Iran soon with the same company as mechanic. As a matter of fact he is probably over there now. Jack hails originally from that colorful Kentucky bailiwick, Louisville, famous for racehorses, the bluegrass that makes them sleek and speedy, and the people who provide the money that goes on their soft noses. He is a comparatively recent California acquisition, having come out to the west in 1945 after a stretch of war construction work in Alaska and the Aleutians.

He began with Drillex when he first arrived and has remained with that concern ever since. It would be expected that the hobby of a Kentuckian would in some manner involve horses but Jack is nothing if he isn't different. He is a golfer—with a swing and a stance that have made many a professional green with envy. His only trouble is that his short game is much too long and his long game is much too short. However, his divots although large are neater than most and even when he misses the ball he does it so gracefully that it looks like an accomplishment. All of which is fairly easy to understand when you know that he once made a hole-in-one at the Cedar Lake Golf Course in Indiana.

DATA ON IMPORTANT OIL FIELDS OF THE UNITED STATES

No.	Year discovered	Field	County	Producing formation	Gravity °API	Productive acres	Estimated average thickness (feet)
				OKLAHOMA (Contd.)			
		Southwestern					
103	1935	Jesse	Pontotoc	Hunton, McLish; Sil-Dev, Ord	40.0	1,235	—
104	1942	Pauls Valley	Garvin	Pen, Bromide	42.0	1,700	—
105	1944	Pauls Valley, E	Garvin	Pen	33.0	1,760	—
106	1934	Altus	Jackson	Granite Wash; Pen	41.0	1,740	30
107	1941	Apache	Caddo	Bromide	40.0	1,000	35
108	1917	Cement	Caddo	Per, Pen	34.0	4,505	—
109	1918	Comanche	Stephens	Stray, Wilcox, Pace	34.0	925	—
110	1920	Duncan, North	Stephens	Thomas	36.0	1,260	—
111	1919	Duncan, West	Stephens	Brown, Blaydes	33.0	910	—
112	1920	Empire	Stephens	Brown, Blaydes	39.0	2,630	—
113	1917	Fox	Carter	Fox sd, Simpson, Oil Creek; Pen, Ord	32.0	1,100	—
114	1937	Frederick, West	Tillman	Canyon, Strawn	37.0	300	19
115	1917	Graham	Carter	Deese; Pen	31.0	3,190	—
116	1913	Healdton	Carter	Headlton, Glenn; U Pen, Ord	31.0	7,550	—
117	1919	Hewitt	Carter	Viola; Pen	34.0	4,530	—
118	1939	Hobart	Kiowa	Pontotoc, Conglomerate	35.0	500	16
119	1924	Knox	Grady	Pontotoc	35.0	1,990	15
120	1937	Milroy, Deep	Stephens	Hunton, Oil Creek; Sil-Dev	42.0	80	71
121	1916	Milroy, Shallow	Stephens	Pontotoc; Pen	26.0	800	—
122	1924	Oscar	Jefferson	Glenn; Pen	33.0	685	25
123	1921	Robberson	Garvin	Pontotoc, Simpson; Pen, Ord	23.0	2,410	—
124	1923	Sholem-Alechem	Carter	Hoxbar, Deese; Pen	29.0	4,760	—
125	1927	Tatums	Carter	Deese, Arbuckle; Pen, Ord	27.0	2,660	60
126	1933	Tussy	Carter	Deese; Pen	23.0	1,340	—
127	1917	Velma	Stephens	Arbuckle; Pen	26.0	3,710	—
128	1917	Walters	Cotton	Cisco, Hoxbar	34.0	3,790	—
129	1914	Wildcat Jim	Carter	Pontotoc, Deese; Pen	24.0	1,235	—
				PENNSYLVANIA			
1	—	*Bradford	McKean	Fourth Kane-Haskell, First & Second Chipmonk	—	—	—
				TEXAS			
		R. R. Com. Dist. 1					
1	1928	Darst Creek	Guadalupe	Austin Ch, Edwards Li; Cre U	36.0	2,120	30
2	1937	Ezell	McMullen, Live Oak	Loma Novia; Eoc	20.0	1,540	11
3	1932	Hilbig	Bastrop	Serpentine; Cre U	37.0	260	50
4	1942	Imogene	Atascosa	Edwards Li; Cre L	39.0	960	30
5	1921, 30	Luling Branyon	Caldwell, Guadalupe	Austin Ch, Edwards Li; Cre L and U	27.0; 37.0	3,100	50
6	1933	Pearsall	Frio	Navarra Sands, Austin Ch, Buda Li; Cre U	28.0	1,280	10
7	1928	Salt Flats	Caldwell	Edwards Li, Austin Ch; Cre L and U	36.0	1,300	30
8	1912	Somerset	Bexar, Atascosa	Taylor Sd, Buda Li	32.0	11,390	20
9	1940	Washburn (N & S)	La Salle	Wilcox; Eoc	41.0	900	20
		R. R. Com. Dist. 2					
10	1939	Bonnieview	Refugio	Greta; Olig	26.0	1,500	33
11	1942	Caeser, South	Bee	Cockfield, Wilcox	42.0	1,100	20
12	1934	Dirks	Bee	Cockfield; Eoc	44.0	865	16
13	1945	Falls City	Karnes	Wilcox; Eoc	45.0	1,500	10
14	1941, 37	Ganado, Deep and and Shallow	Jackson	Vicksburg, Frio; Olig	25.0-35.0	2,280	15
15	1940	Ganado, West	Jackson	Frio, Het; Olig	24.0	1,760	15
16	1933	Greta, incl Deep	Refugio	Oakville, Catahoula, Het, Frio; Olig, Mio	23.0-29.0	4,400	15
17	1936	Heyser	Calhoun, Victoria	Frio; Olig	31.0-43.0	5,500	25
18	1938	La Rosa	Refugio	Frio; Olig	29.0-39.0	1,940	50
19	1941	La Ward, North	Jackson	Marg, Frio; Olig	26.0	5,000	10
20	1940	Lolita	Jackson	Marg, Frio; Olig	26.0-33.0	3,100	19
21	1930	McFaddin	Victoria	Frio, Vicksburg	20.0-40.0	1,000	15
22	1941	Maurbro	Jackson	Frio; Olig	24.0	3,275	10
23	1942	Mayo	Jackson	Frio; Olig	29.0	1,600	10
24	1935	Placedo	Victoria	Het, Frio; Olig	22.0-29.0	3,000	15
25	1937	Placedo, East	Victoria	Frio; Olig	38.0	600	10
26	1920	Refugio	Refugio	Catahoula, Frio; Olig	23.0-40.0	8,000	15
27	1931	Refugio Fox	Refugio	Catahoula, Frio; Olig	36.0	730	10
28	1943	Slick Wilcox	Goliad, Dewitt	Wilcox Sd; Eoc	36.0	1,500	50
29	1934	Tom O'Connor	Refugio	Frio; Olig	35.0	12,000	175
30	1938	West Ranch	Jackson	Het, Marg, Frio; Olig	26.0-40.0	10,000	24
		R. R. Com. Dist. 3					
31	1936	Amelia	Jefferson	Frio, Marg; Olig	27.0-29.0	1,000	15
32	1935	Anahuac	Chambers	Frio; Olig	32.0	6,680	55
33	1918	Barbers Hill	Chambers	Mio; Olig	25.0-29.0	600	50

*Includes that portion of the Bradford Field which lies in New York state.

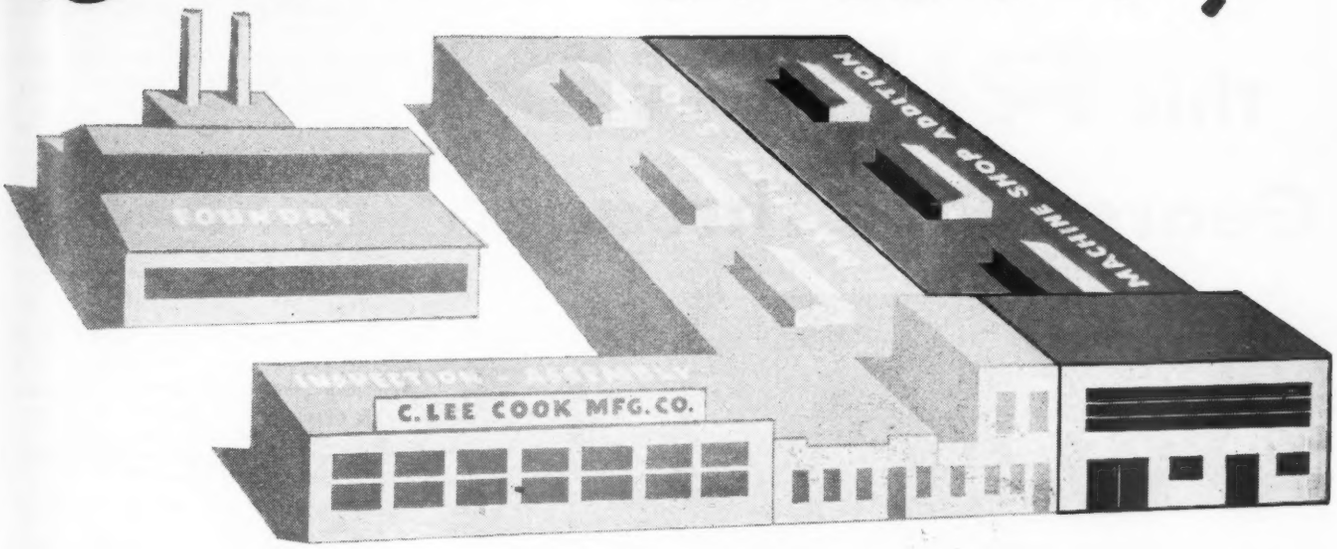
From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

DATA ON IMPORTANT OIL FIELDS OF THE UNITED STATES

No.	Annual production (thousands of barrels)						Cumulative production thru 1947 (M bbl)	Estimated recovery per acre (bbl)	Number wells producing		
	1942	1943	1944	1945	1946	1947			Total	Flowing	Pumping
							OKLAHOMA (Contd.)				
		Southwestern									
103	662	618	562	520	495	414	8,227	6,326	—	—	—
104	803	1,989	3,934	3,199	2,216	1,890	14,033	7,143	—	—	—
105	0	0	242	1,215	733	515	2,705	1,244	—	—	—
106	230	172	160	137	123	106	2,472	1,360	122	0	122
107	1,749	2,303	2,285	2,310	1,597	1,799	12,217	10,418	—	—	—
108	3,249	2,575	4,173	5,105	4,732	4,444	47,187	9,488	—	—	—
109	158	140	133	118	110	99	11,154	1,195	126	0	126
110	129	127	117	110	100	109	4,919	3,817	82	0	82
111	103	104	358	710	679	551	8,402	8,627	—	—	—
112	783	633	457	378	351	476	17,076	6,312	—	—	—
113	299	259	238	218	207	203	16,018	14,377	91	0	91
114	596	354	233	210	150	110	3,797	1,229	23	0	23
115	333	318	309	346	298	282	28,304	8,784	250	0	250
116	2,826	2,614	2,506	2,416	2,434	2,435	205,780	26,933	—	—	—
117	3,327	2,368	2,037	1,799	1,709	1,661	105,412	22,903	902	0	902
118	386	71	44	35	31	27	1,558	3,062	10	0	10
119	550	491	422	388	375	518	17,765	8,667	—	—	—
120	111	105	76	61	40	32	851	8,190	1	0	1
121	104	100	94	87	92	103	3,934	4,789	150	0	150
122	432	384	362	331	319	477	12,506	17,561	—	—	—
123	310	288	274	258	252	233	16,794	6,872	154	0	154
124	842	793	798	747	710	725	42,492	8,775	—	—	—
125	563	605	591	562	561	631	19,694	7,167	—	—	—
126	1,064	868	1,071	875	890	1,068	10,211	6,823	—	—	—
127	435	683	682	892	1,890	5,972	16,319	2,796	878	—	—
128	283	259	243	223	275	301	27,019	7,050	228	0	228
129	382	512	499	538	710	1,138	20,753	15,883	155	—	—
							PENNSYLVANIA				
1	15,532	13,684	12,162	10,793	11,757	11,612	502,895	—	—	—	—
							TEXAS				
		R. R. Com. Dist. 1									
1	2,193	2,738	3,399	2,919	2,700	2,525	67,350	30,578	317	1	316
2	—	243	228	211	219	199	3,890	2,397	121	0	121
3	64	130	297	240	230	248	2,846	9,992	12	12	0
4	0	29	124	183	295	236	868	658	33	22	11
5	1,768	1,764	1,879	1,572	1,423	1,528	89,505	28,380	651	8	643
6	179	256	393	421	435	456	3,641	2,488	52	7	45
7	1,008	826	710	629	557	509	47,027	35,783	202	10	192
8	141	87	66	55	55	52	11,378	994	254	0	254
9	77	115	339	355	308	254	1,474	1,355	20	5	15
		R. R. Com. Dist. 2									
10	0	0	8	351	811	1,174	2,344	780	—	—	—
11	86	361	646	595	651	521	2,895	2,134	38	35	3
12	114	201	387	376	241	152	7,443	8,429	65	0	65
13	0	0	0	245	1,176	1,506	2,927	947	60	58	2
14	297	396	507	580	606	629	3,272	1,159	54	47	7
15	327	443	616	558	764	919	3,777	1,624	56	53	3
16	1,173	1,463	3,130	2,946	3,423	3,733	44,399	6,970	199	163	36
17	2,927	3,334	3,332	2,804	2,284	2,007	30,923	5,257	177	111	66
18	360	638	1,636	1,435	1,304	1,357	10,086	4,499	72	61	11
19	543	743	929	1,029	919	808	5,004	839	99	78	21
20	2,258	1,886	2,143	2,257	2,301	2,224	14,760	4,044	220	187	33
21	834	1,749	2,036	1,663	1,712	1,814	12,662	10,848	80	53	27
22	505	403	646	697	722	704	3,882	665	83	66	17
23	100	330	558	686	602	494	2,766	1,420	42	28	14
24	1,133	1,495	1,772	1,617	1,639	1,740	21,875	6,712	134	28	106
25	587	252	470	533	519	474	2,829	3,925	34	29	5
26	1,219	1,428	1,655	1,832	2,252	2,744	50,396	5,957	186	107	79
27	79	88	238	194	170	288	5,202	6,731	20	17	3
28	0	62	844	1,417	1,629	1,676	5,628	2,635	48	44	4
29	6,915	12,690	18,744	17,730	15,881	17,722	115,961	8,187	572	571	1
30	5,243	6,826	8,131	7,150	7,109	7,063	47,334	4,027	456	433	23
		R. R. Com. Dist. 3									
31	1,380	1,671	1,691	1,484	1,493	1,590	15,015	13,425	88	88	0
32	3,588	8,902	11,885	11,116	10,125	10,688	76,426	9,841	353	315	38
33	2,682	2,343	2,066	1,887	1,849	1,935	87,060	141,875	126	24	102

From The Petroleum Data Book, Second Edition, which carries 750 pages of information on the petroleum industry.

But — WAIT!



We're stepping up production of Cook Piston Rings and Packings... *a big 50%*

We're not ashamed to admit it — we've been having a difficult time keeping up with the tremendously increased demand for Cook piston rings and packings.

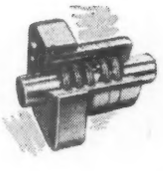
Our production lines have long been working at top capacity to maintain satisfactory delivery schedules. But, when you're turning out precision-made products you just don't cut corners. Cook packings and piston rings have an established reputation for superior performance, and we are unwilling to deviate from the rigid engineering and manufacturing standards that have made this possible. Our customers' confidence in our products is one of our most valued assets.

Yes, maintaining these standards and keeping up with orders has been a big problem. Now, at last, we're able to do something about it. We're adding a new modern machine shop to our present plant. The new addition will boost present capacity a whopping 50%.

Sure, we're doing everything possible to give you as prompt service as possible now — BUT, WAIT until our new plant goes into operation — we're *growing* to give you even better service.

C. Lee Cook Mfg. Co., Incorporated, Louisville, Ky. Branch offices in Baltimore, Boston, Chicago, Cleveland, Houston, Los Angeles, Mobile, New Orleans, New York, San Francisco and Tulsa.

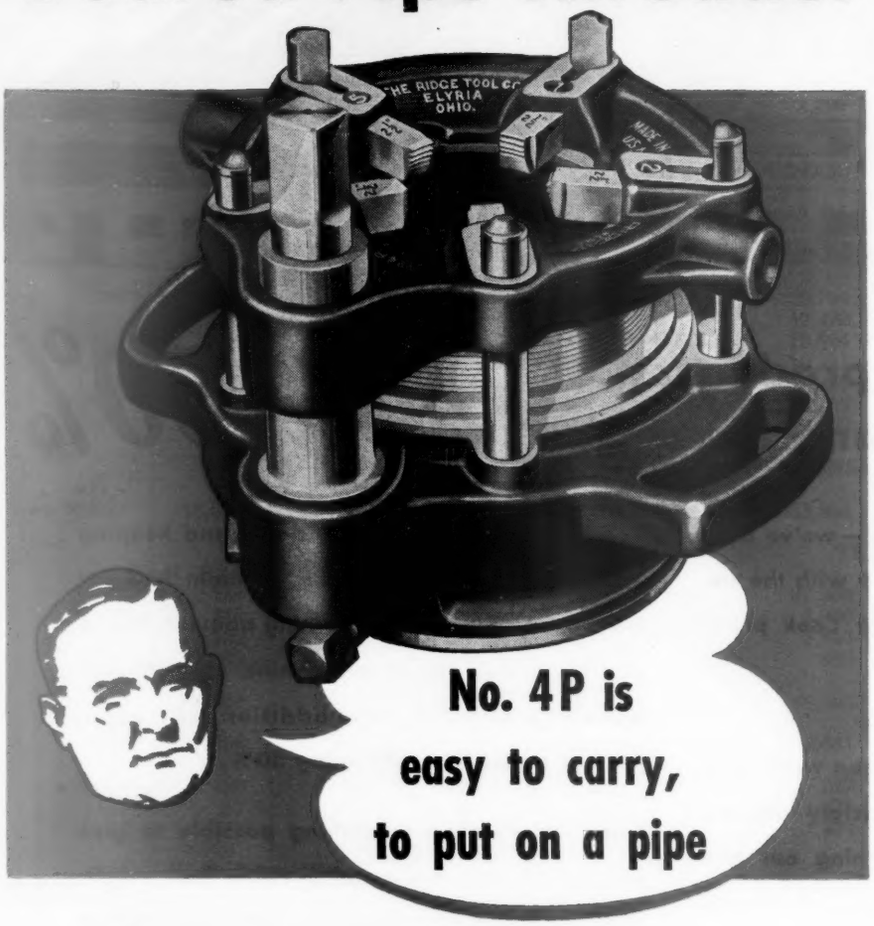
GRAPHITIC IRON **COOK** ROD PACKINGS



GRAPHITIC IRON **COOK** PISTON RINGS

. . . SEALING PRESSURES SINCE 1888 . . .

Easier to Handle this RIDGID Geared Pipe Threader



● You'll like the balanced loop handles that make it easy to swing the 4P around where you want it. Making it still more of a work-saver, mistake-proof workholder sets to size *before* you put it on pipe—only one screw to tighten, no bushings to fool with. 4 sets of 5 high-speed steel chaser dies give quick, clean threads on 2½", 3", 3½" and 4" pipe. Ratchet handle furnished—for power threading use with RIDGID Universal Drive Shaft and Power Drive. Save your muscles—buy this easier-to-handle RIDGID 4P at your Supply House.

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MEETINGS

American Association of Oil Well Drilling Contractors
Annual Meeting, Fort Worth, Texas, Sept. 24-25.

American Assn of Petroleum Geologists
Regional Meeting, Commodore Perry, Austin, Texas, Oct. 18-20.
Pacific Coast Section Fall Meeting, Los Angeles, Nov. 1-2.

American Chemical Society
Southwide Chemical Conference, Wilson Dam, Alabama, Oct. 18-20.

American Gas Association
Accident Prevention Committee, Hotel Phillips, Kansas City, Missouri, Sept. 17-18.
Annual Convention, Kiel Auditorium, St. Louis, Missouri, Oct. 15-17.

American Institute of Chemical Engineers
Regional Meeting, Sheraton Hotel, Rochester, New York, Sept. 17-19.
Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey, Dec. 2-5.

American Institute of Mining and Metallurgical Engineers
Annual Petroleum Branch Meeting, Oklahoma Biltmore, Oklahoma City, Oklahoma, Oct. 3-5.

American Oil Chemists' Society
Fall Meeting, Edgewater Beach Hotel, Chicago, Illinois, Oct. 8-10.

American Petroleum Credit Association
Annual Conference, Adolphus Hotel, Dallas, Texas, Oct. 15-17

American Petroleum Institute
Lubrication Committee Meeting, Traymore, Atlantic City, New Jersey, Sept. 12.
Annual Meeting, Stevens Hotel and Palmer House, Chicago, Illinois, Nov. 5-8.

American Society of Mechanical Engineers
Industrial Instrument and Regulators Division, Coliseum, Houston, Texas, Sept. 10-14.
Petroleum Mechanical Engineering Conference, Mayo Hotel, Tulsa, Oklahoma, Sept. 24-26.
Fall Meeting, The Radisson, Minneapolis, Minnesota, Sept. 25-28.
Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, New Jersey, Nov. 25-30.

American Society for Metals
Annual Seminar, Michigan State Fair Grounds, Detroit, Michigan, Oct. 13-14.
World Metallurgical Congress, Detroit, Michigan, Oct. 14-19.
Annual Metal Show and National Metal Congress and Exposition, Detroit, Michigan, Oct. 15-19.

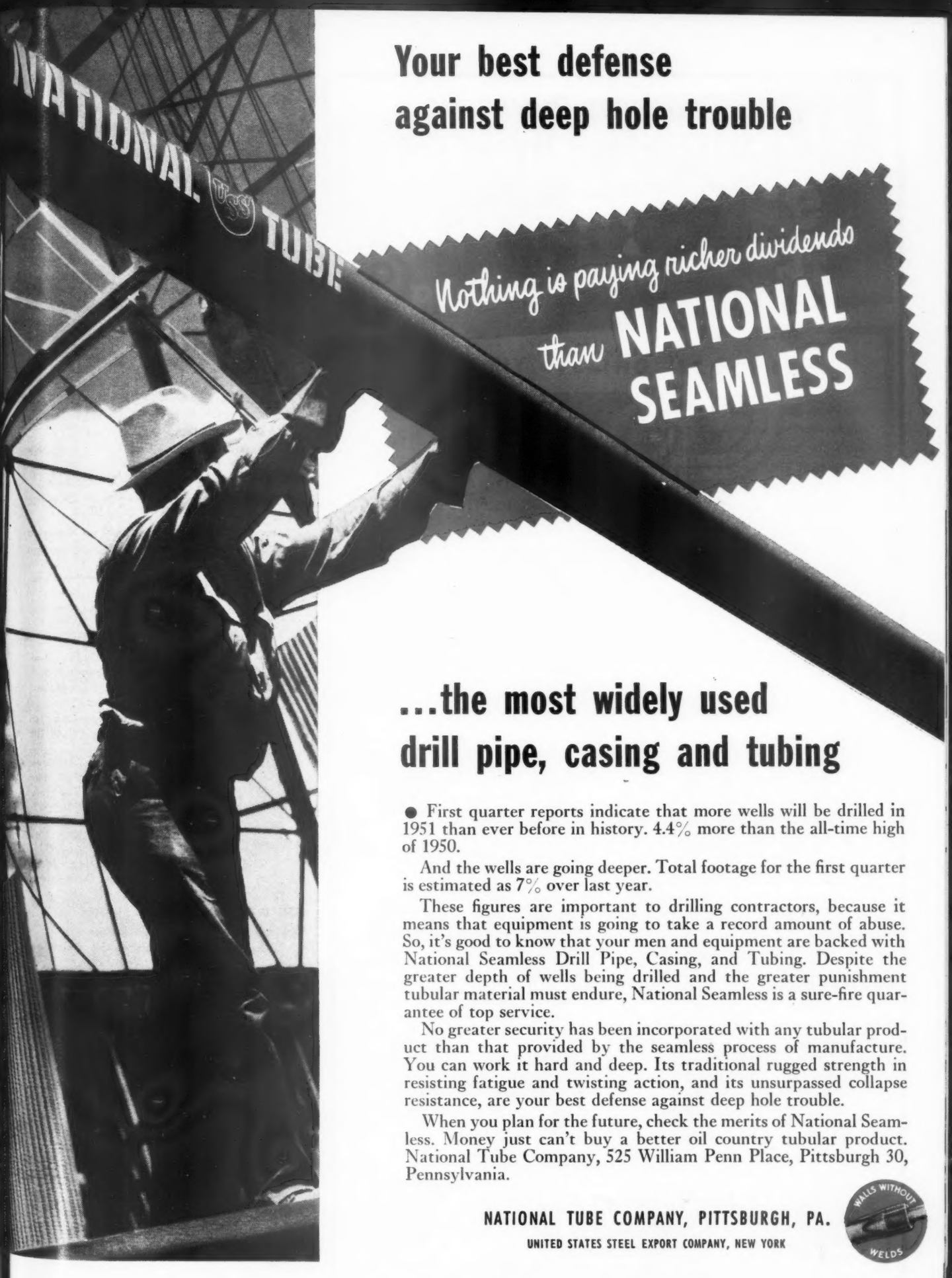
American Society for Testing Materials
Spring Meeting and Committee Week, Hotel Statler, Cleveland, Ohio, March 3-7, 1952.
Fiftieth Anniversary Meeting, New York City, June 23-27, 1952.

Chemical Industries Exposition
Grand Central Palace, New York City, N. Y., Nov. 26-Dec. 1.

Coastal Engineering Conference
Rice Hotel, Houston, Texas, Nov. 7-10.

Diffraction Conference
Ninth Annual Meeting, Mellon Institute, Pittsburgh, Pennsylvania, Nov. 29-30.

Gulf Coast Assn of Geological Societies
First Annual Meeting, Roosevelt Hotel, New Orleans, Louisiana, Nov. 15-17.



Your best defense against deep hole trouble

Nothing is paying richer dividends than **NATIONAL SEAMLESS**

...the most widely used drill pipe, casing and tubing

● First quarter reports indicate that more wells will be drilled in 1951 than ever before in history. 4.4% more than the all-time high of 1950.

And the wells are going deeper. Total footage for the first quarter is estimated as 7% over last year.

These figures are important to drilling contractors, because it means that equipment is going to take a record amount of abuse. So, it's good to know that your men and equipment are backed with National Seamless Drill Pipe, Casing, and Tubing. Despite the greater depth of wells being drilled and the greater punishment tubular material must endure, National Seamless is a sure-fire guarantee of top service.

No greater security has been incorporated with any tubular product than that provided by the seamless process of manufacture. You can work it hard and deep. Its traditional rugged strength in resisting fatigue and twisting action, and its unsurpassed collapse resistance, are your best defense against deep hole trouble.

When you plan for the future, check the merits of National Seamless. Money just can't buy a better oil country tubular product. National Tube Company, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

NATIONAL TUBE COMPANY, PITTSBURGH, PA.

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

WALLS WITHOUT WELDS

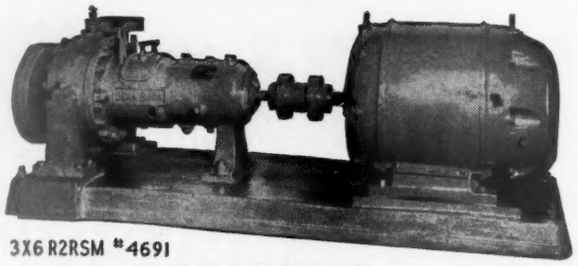
USS

NATIONAL SEAMLESS DRILL PIPE, CASING AND TUBING

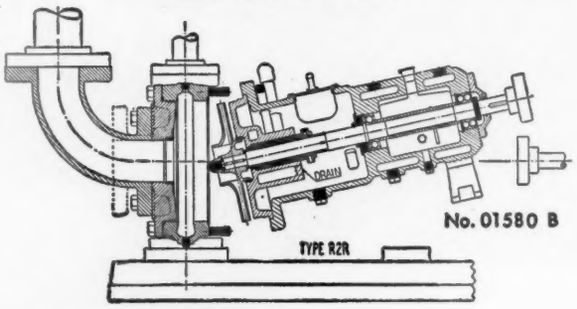
UNITED STATES STEEL

DEAN BROTHERS PUMPS INC.

Type R2R Centrifugal Process Pumps



Type R2R Process Pump



Type R2R Process Pump

DISASSEMBLY: The Type R2R process pumps can be disassembled without disconnecting the suction and discharge piping. By first removing the spacer from the spacer type coupling, and unbolting the casing from the cradle the entire cradle and complete rotating element can be removed without disturbing the suction and discharge piping.

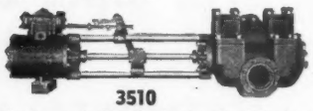
OPERATING RANGE: Type R2R, Heavy duty, process pumps are available in eighteen different sizes, enabling our engineers to furnish units specially designed and constructed for the particular work to be performed.

Capacities: 50 to 2000 Gallons per minute. **Heads:** Up to 400'. **Speeds:** 900 RPM to 4000 RPM.

BUILDERS OF OUTSTANDING PUMPS SINCE 1869

CENTRIFUGAL and RECIPROCATING PUMPS

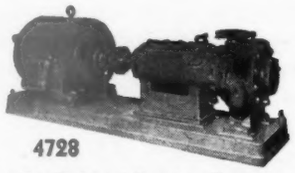
Close Coupled Centrifugal Pump



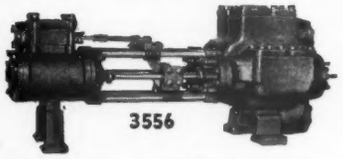
Horizontal, Single Style, Double Acting, Piston Type, Close Clearance Pump. Designed to handle volatile liquids

Pedestal Mounted Centrifugal Pump

Horizontal, Duplex, Double Acting. Side Pot, Piston Type, Oil Bath Power Pump



Double Pedestal Bearing Centrifugal Pump



Durable Duplex Packed Piston Pattern Steam Pump, Side Pot Type

ESTABLISHED 1869

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Branch Offices: NEW YORK, N. Y., HOUSTON, TEXAS

Representatives in Principal Cities

Independent Petroleum Assn of America
Annual Meeting, The Shamrock, Houston, Texas, Oct. 22-23.

Instrument Society of America
National Conference annd Exhibit, Sam Houston Coliseum, Houston, Texas, Sept. 10-14.

Institute of Gas Technology
Annual Meeting, Chicago, Illinois, Oct. 18.

Louisiana Golden Oil Jubilee
Jennings, Louisiana, Sept. 21-23.

Mid-Continent Oil and Gas Association
Texas Division, Annual Meeting, Beaumont, Texas, Oct. 8-9.
Louisiana-Arkansas Division, Annual Meeting, Roosevelt Hotel, New Orleans, Louisiana, Nov. 1-2.

National Assn of Corrosion Engineers
South Central Region, Corpus Christi, Texas, Oct. 18-20.
Annual Conference, Chicago, Illinois, March 10-14, 1952.

National Petroleum Association
Meeting, The Traymore, Atlantic City, New Jersey, Sept. 12-14.

National Lubricating Grease Institute
Annual Meeting, Edgewater Beach Hotel, Chicago, Illinois, Oct. 29-31.

Natural Gasoline Association of America
Southern Regional Meeting, Blackstone Hotel, Tyler, Texas, Oct. 19.
Panhandle-Plains Regional, Herring Hotel, Amarillo, Texas.
Annual Convention, Rice Hotel, Houston, April 30-May 2, 1952.

Nomads
Dallas-Fort Worth Chapter, Dallas, Sept. 4, Oct. 29, Dec. 3; Fort Worth, Oct. 1.
Houston Chapter, Ye Olde College Inn, Second Monday of the month.
Los Angeles Chapter, Jonathan Club, Los Angeles, Second Wednesday of the month.
New York Chapter, Luncheon, Downtown Athletic Club, Sept. 11. Fall Golf Party, Knoll Golf Club, Boonton, New Jersey, Sept. 18. Regular meeting, Oct. 1 and 29. Christmas Dance and Dinner, Hotel Pierre, New York City, Dec. 8.
Tulsa Chapter, Regular Meeting, After-Five Room, Hotel Tulsa, Third Friday each month.

Oil Progress Week, Oct. 14-20.

Oklahoma Utilities Association
Gas Division, Biltmore Hotel, Oklahoma City, Oklahoma, Sept. 21.

Oil Industry Information Committee
Stevens Hotel, Chicago, Illinois, Nov. 3-8.

Society of Automotive Engineers
National Diesel Engine Division, The Drake, Chicago, Illinois, Oct. 29-30.
Fuels and Lubricant Division, Drake Hotel, Chicago, Illinois, Oct. 31-Nov. 1.
National Transportation Meeting, Knickerbocker Hotel, Chicago, Illinois, Oct. 29-31.

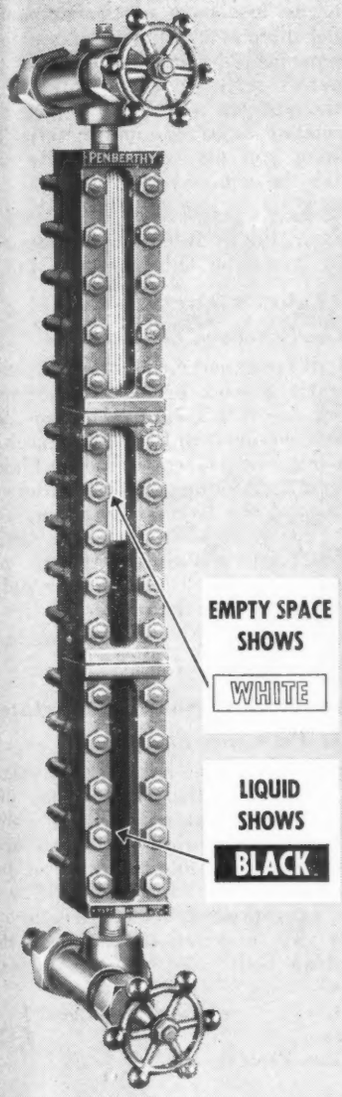
Society of Exploration Geophysicists
Eastern Regional Meeting, Webster Hall Hotel, Pittsburgh, Pennsylvania, Oct. 25.
Pacific Coast Section, Ambassador Hotel, Los Angeles, California, Nov. 1-2.
Mid-West Regional Meeting, Baker Hotel, Dallas, Texas, Nov. 19-20.

South Texas Blowout
Alice, Texas, Dec. 3-4.

Western Petroleum Refiners Association
Regional Meeting, Hotel Henning, Casper, Wyoming, Sept. 20-21.

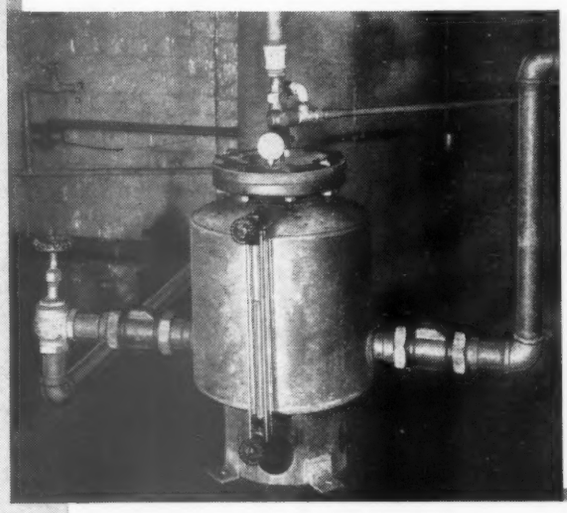
PENBERTHY PRODUCTS THAT improve PROCESS AND PLANT

PENBERTHY REFLEX LIQUID LEVEL GAGES



You can't misread the Penberthy Reflex Liquid Level Gage . . . *it prevents mistakes.* Due to a simple, invariable optical principle, the empty space always shows white . . . the liquid black. In addition to standard units, Penberthy Reflex Gages are fabricated to customers' specifications from special alloys to meet unusual corrosive, pressure and temperature conditions. Write for new Catalog No. 35.

PENBERTHY CYCLING JET PUMPS

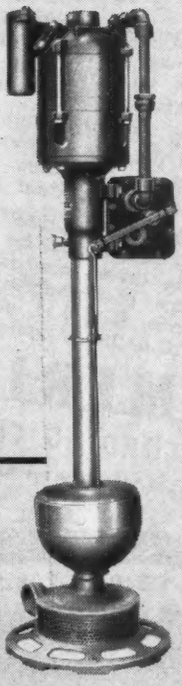


Operated by air, gas, or steam pressure, pumps (without clogging) any liquid that will flow through pipes. Lifts fluid from lower level and discharges against pressure approximately equal to operating gas pressure. Operates automatically by ejector that exhausts the vessel . . . drawing in liquid . . . then gas pressure pushes it out. Ejector and its control valve not in contact with fluid pumped. Corrosion proofing easy. Write for Bulletin 5030.

PENBERTHY EJECTORS

A simple jet pump operated by air, water or steam. Has no moving parts . . . needs no lubrication. Will not get out of order . . . wear is not appreciable. Reliable, noiseless, compact, convenient and initial cost is very low. Made in bronze, iron and wide variety of materials that successfully withstand corrosion, contamination and high temperatures. Special units developed to meet unusual conditions. Write for Catalog 34.

PENBERTHY *Explosion Proof* SUMP PUMPS



Motor and switch totally enclosed, this pump has Underwriters approval for Class I, Group D, and Class II, Groups E, F and G hazardous locations. These include gasoline, solvent vapors, metal dust, natural gas, carbon black, naphtha, alcohol, grain dust, acetone, lacquer, coal and coke dust, etc. Made of copper and bronze throughout, this pump is corrosion proof, durable, thoroughly dependable. Write for Bulletin 4929.

PENBERTHY ALSO MANUFACTURES A COMPLETE LINE OF LIQUID LEVEL GAGES IN BRONZE, IRON, STEEL AND ALLOYS

PENBERTHY PRODUCTS

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DETROIT 2, MICHIGAN

DIVISION OF THE BUFFALO-ECLIPSE CORPORATION

Established 1886 *Canadian Plant, Windsor, Ontario*

LETTERS *to the* EDITORS

B-A Background Cited

To The Petroleum Engineer:

In a recent memorandum from H. C. Plummer, Montreal, it was stated that in some quarters in the United States, The British American Oil Company Limited is regarded as an affiliate of a British capitalization.

British American Oil is an all-Canadian company founded by a Canadian, the late A. L. Ellsworth, in 1906. It is a fully integrated company having operations in all 10 provinces of Canada, has 6000 retail outlets, 4000 employees, and five refineries (Montreal, Clarkson, Moose Jaw, Calgary, Edmonton).

In 1924 and 1925, British-American organized two fully owned subsidiaries in the United States—The Toronto Pipe Line Company and The British-American Oil Producing Company. Engaged in exploration, crude oil production, and pipe line activities, these companies were formed to insure B-A of adequate quantities of crude. The British-American Oil Producing Company at the present time either owns or has an interest in approximately 1500 oil and gas wells in the United States.

On the last page of the Edmonton booklet there is a resume in chronological sequence covering highlights of the company's forty-five years growth.

I thought you would like to have this information as background material for anything you may care to write concerning the company.

H. D. Ringland.

Manager, Public Relations Department, British-American Oil Company, Ltd.

We Take a Curtain Call

To The Petroleum Engineer:

In all my experience with publication in nearly a score of different journals I have never had more courteous and efficient service than I have just received from you. The paper, "Studies in Fluidization," H. L. Olin and J. S. Patterson. *The Petroleum Engineer*, Refining and Gas Processing Edition, June, 1951, page C-5, is beautifully set up and printed and both Dr. Patterson and I are delighted with the work.

H. L. Olin,

State University of Iowa.

Mexican Gulf Not Expropriated

To the Petroleum Engineer:

I read in the June issue of your magazine, page A-10 that Mexico has just paid to the Mexican Gulf Oil Company, which was expropriated 13 years ago.

There is a misinterpretation of the news because the "Mexican Gulf" was never expropriated, it was bought recently by negotiations between the "Mexican Gulf" and "Petroleos Mexicanos."

Humberto Lobo, Jr.

Manager,
Fabricas Protexa, S.A.

Measurement Society Greeted

To The Petroleum Engineer:

We read with interest the article in your April 1951 issue, whose caption is "The First Measurement Society Growing in Membership." We are happy to hear of measurement men organizing in another part of the country. We know that they will receive the outstanding technical and social benefits from their organization that measurement men of Southern California have received from the Southern California Meter Association in its 24-year history.

From the context of the article, we are sure that we have mutual aims and interests and are looking forward to hearing from the Ark-La-Tex Association.

The Board of Directors and the 489 members of the Southern California Meter Association extend greetings and best wishes to the new association.

Donald R. A. Jones.

Publicity Chairman
Southern California Meter Association.

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8 DAY
CHARTS
and
ROCKWELL CHART DRIVES
EIGHT-DAY ARCCO CHARTS are now available for use on practically all Rockwell-Emco, Foxboro and Westcott orifice meters. Eight day charts for other instruments soon available.
With this NEW Chart Drive 11 rotation speeds are possible. Turrets are available for 2, 3, 4, 6, 8 and 12 hours, also for 2, 3, 7, and 8 day rotation. Standard hub gives 24 hour rotation.
ROCKWELL CHART DRIVES are ruggedly built and are sealed for years of trouble-free service. The drives are adaptable to practically every type of instrument using circular charts. The price is $11.55 each. Turrets are $3.85 each F.O.B. Los Angeles Calif. or Tulsa, Oklahoma.
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THE Petroleum Engineer
September, 1951

P 980.

OIL in TROUBLED WATERS

ERNESTINE ADAMS*

THE "tidelands" case is so masked by high-capped waves of double talk that if you go out far enough you are in danger of drowning in confusion. What looked like water turns out to be oil and what is called tidelands has nothing to do with lands overflowed by tides. Officials of California, Louisiana, Texas, and other states warn of a typhoon of federal power coming our way; U.S. senators from Wyoming, Illinois, and Alabama conjure heavy oil on the waters ready to be siphoned into federal coffers for "all the people."

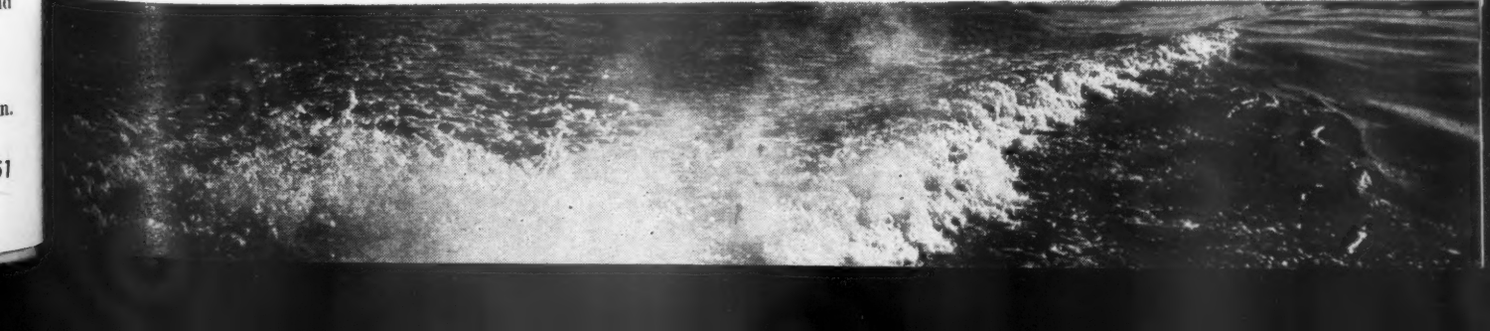
Three Supreme Court decisions stated that Uncle Sam has "paramount rights" in the subsea lands bordering California, Louisiana, and Texas. A large majority of Congress demonstrated its belief the lands belong to the states by passing a disclaimer resolution. President Truman vetoed this and in his State of the Union speech January 4, 1949, he called for development of petroleum reserves under the sea "which are — and must remain—vested in the federal government."

The forces that oppose each other on the question have been pounding at a public opinion so confused as to seem indifferent.

How can you make up your mind when you can't see the water for the waves? There are thundering sound waves thrown out by General Marshall, Secretary of Defense, and the Department of Interior that the oil in the "tidelands" is needed for defense and the military would prefer to deal for oil with the federal government. Even the State Department added some ripples for federal oil control. Senators Hill of Alabama and Douglas of Illinois, both Democrats, are making a big splash about using the funds from "tidelands" oil for federal-fi-

*Managing Editor.

EXCLUSIVE



nanced education. Former Secretary of Interior Harold Ickes began sounding that theme in 1948. Senator Hill added that giving the tidelands oil to all the people was the big chance for the oil industry to forestall nationalization as occurred in Iran. Senator O'Mahoney of Wyoming, chairman of the Interior and Insular Affairs Committee, begs interior states to believe the federal government will assert no claims to submerged lands beneath inland waters while Texas Attorney General Price Daniel warns that the acquisitive hand of federal government is stretching in that direction.

Waves from the three states thus far sued are smaller but the surf along their coastline raises a mighty rumble. They have been robbed, they say. The receipts for state "tidelands" leases and royalties have not been large so far but they have helped pay for state parks in California, helped reduce the Louisiana state debt, and aided state schools in Texas.

The tidelands case is muddied by false terms and splashed with political promises. It overflows into geological history and backwashes into the history of the U. S. government in oil business.

The Legal Question

Once there was calm on the marginal seas. What happened?

The area in dispute is not the tidelands. It is the submerged land from low tide out to the sea three miles or more, which in international law belongs to the sovereign of the adjacent land. Since the joining of the original thirteen into the United States the area has been under control of adjacent states. The continental shelf outside the marginal belt is considered U.S. territory and the actual tidelands, or the lands between high and low tide, belong to the states. Some states have reclaimed sections of the sea bed for wharfs, airports, building sites, etc. Some have authorized leases or licenses for fish, shrimp, lobsters, oyster beds, kelp (seaweed, a source of iodine) and for oil exploration.

Applicants for federal oil leases, which may cost a fraction of what state leases bring, began the agitation against this accepted status of ownership. Although oil was found in the California "tidelands" as early as 1894 the demand for federal leases apparently awaited a climate favorable to federal control.

The determined undertow of federal lease applicants was at first withstood by Secretary of Interior Ickes, who in 1933 replied to one applicant that the title "is in the state and not in the U.S." and "therefore no rights can be granted to you, either under the Leasing Act of . . . 1920 or any other public land law . . . The land may not be appropriated except by authority of the State of California. . ."

Regardless of this authoritative statement an ambitious group continued to pile up applications for oil leases in the Department of Interior (as they continue to do), often over land already leased by the state. Instead of returning the applications Ickes kept them, perhaps because some of the names on them were of some political importance. Finally the undertow flipped him over, because—he once told a Congressional committee—of the insistence of "applicants for (federal) leases and their attorneys." In 1937 he tried to get Congress to pass a bill granting title of the subsoil of territorial seas to the federal government. Congress refused.

Three Supreme Court Cases

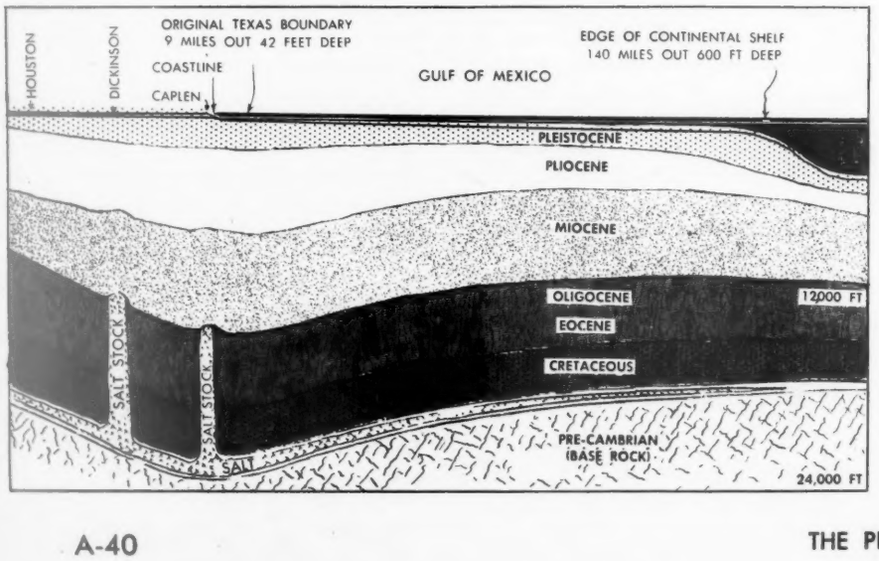
After time out for World War II the controversy was taken to the U.S. Supreme Court in the case of *U. S. vs. California* to establish federal claims to submerged lands from low tide to three miles offshore. President Truman vetoed a disclaimer bill passed by Congress on the grounds that no move should be made until the Supreme Court passed on the case.

In 1947 the Supreme Court decided that the federal government has "paramount rights in and power over that belt, (off California) an incident to which is full dominion over the resource of the soil under that water area, including oil."

Justices Reed and Frankfurter dissented. In his written opinion Frankfurter discussed the differences between *dominium* and *imperium*. *Dominium* means ownership of property; *imperium* means political sovereignty over the same. You have dominion over the home you own but it is under the political sovereignty of the United States.

Boiled down the majority decision of the court seemed to say the U.S. government could not adequately exercise political control without the right to control any oil development. Said Mr. Justice Black: "The crucial question is not merely who owns the bare legal title to the lands. . . The United States here asserts rights in two capacities transcending those of

The Texas marginal sea and the continental shelf. *A small margin for error.*



a mere property owner." In his dissent Mr. Justice Reed said: "The power of the United States is plenary (complete) over these undersea lands precisely as it is over every river, farm, mine, and factory of the nation."

To many jurists the Court decision was a new concept of federal powers. It seemed to throw a shadow of federal dominion—or ownership—over all property within the limits of U.S. political sovereignty.

Meantime the nation's demand for its products made the oil industry decide that the risk and expense of prospecting for oil in the submerged lands of the Gulf of Mexico was worthwhile. The coastlands of Louisiana and Texas had yielded oil and gas so the industry explored the shallow waters of the Gulf under leases from the states. Before the final judgment of the economic success or failure of this venture could be made, the federal government sued these two states for their marginal seas.

The second case was *U.S. vs. Louisiana.* Instead of suing all the 28 states that touch the seas, the U.S. attorney general was taking one at a time and so far only those with oil or oil prospects and only those for which applications for federal leases to their marginal seas had been filed. This action brought an accusation of "divide and conquer" from defendant states.

Louisiana, in practical effect, would suffer most from an adverse decision. Much of the state's wealth was in the leases and royalties from oil and gas production in its tidelands, its maritime belt, and in submerged lands 24 miles to sea, which the state legislature had declared to be also within its boundaries.

Louisiana lost. Mr. Justice Douglas in the majority opinion conceded that *dominium* and *imperium* are normally separable and separate but in the marginal sea "property is so subordinate to the rights of sovereignty as to follow sovereignty." This may sound like legal metaphysics to the layman. It apparently means that Justice Douglas thinks Uncle Sam could not regulate commerce and protect our shores without control of the soil under the marginal seas.

Referring to the decision Roscoe Pound, former dean of Harvard Law School, stated: "The proposition is not the common law, is not international law, and is not involved in, much less required by, the constitutional power and responsibilities of the United States."

Texas had been lulled into the belief she would retain her submerged lands because of the terms of her admission to the United States and the state had assurance from top politicians that her cause was respected. As a Republic Texas had ownership of submerged lands 10½ miles out in the Gulf from low tide. This was the boundary fixed by the Congress of the Republic of Texas in 1836. No direct mention of the maritime border was made in the treaty for annexation except that the state was to retain all vacant lands "lying within its limits."

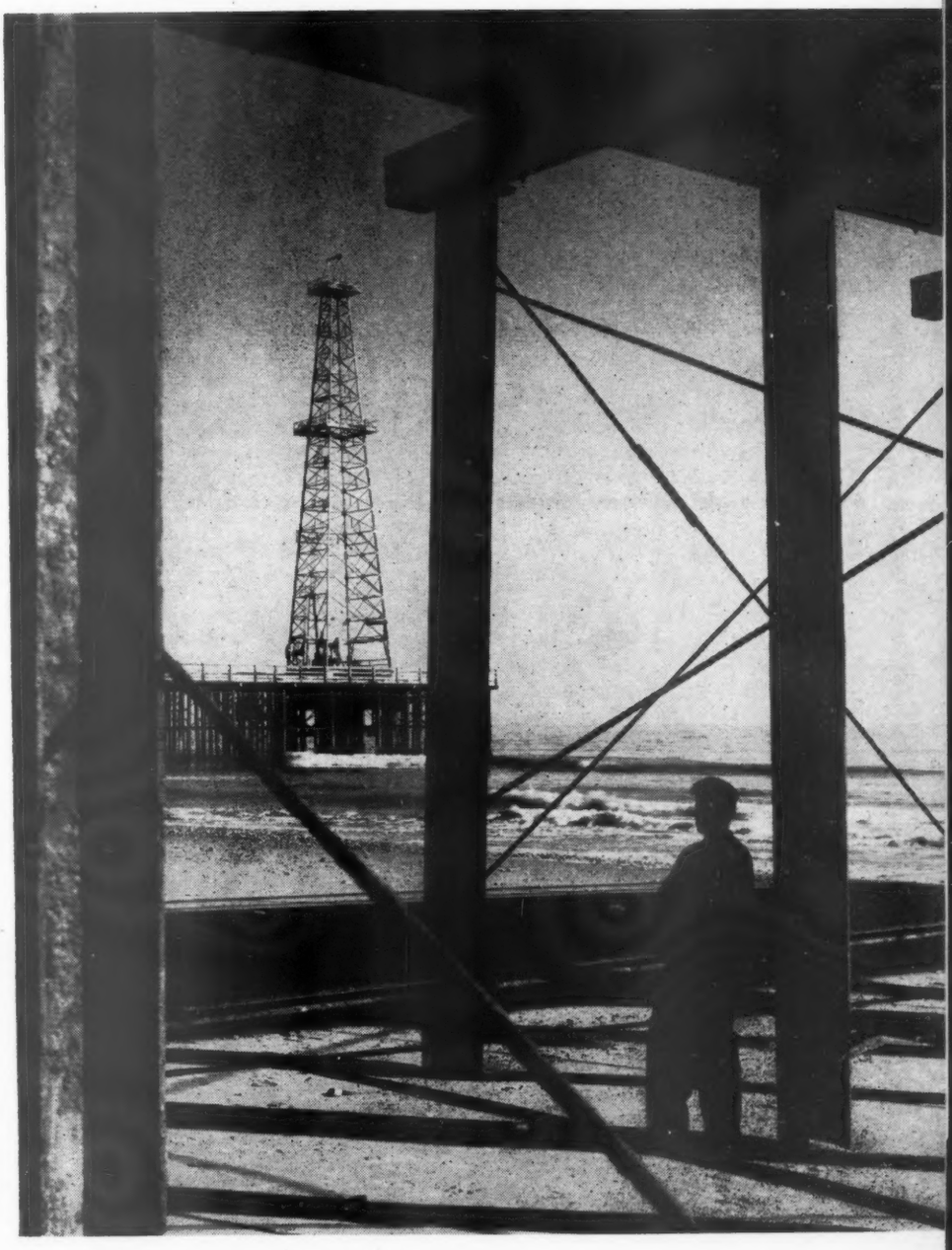
In his 1948 campaign trip, President Truman, when questioned about the "tidelands" case, said, "Texas is in a class by itself; it entered the Union by treaty." Texas-born Attorney General Tom Clark said that Texas retained the lands it owned as a Republic.

A month after Texas gave Truman the largest majority of any Democratic state, Attorney General Clark stated, "It is the position of the U.S. that the rule there announced (California case) is equally applicable to the sea bed and subsoil of the Gulf of Mexico adjacent to Texas." At the President's instruction he filed suit against his native state.

When the decision came, in the *U.S. vs. Texas* case, the whole state was shocked. By a four to three vote the Court refused to allow a trial in the lower courts and refused to hear evidence in its own proceedings. The decision was that Texas came into the Union "on equal footing" with other states and therefore did not own its adjacent sea.

Mr. Justice Douglas gave the majority opinion, which was concurred in by Mr. Chief Justice Vinson, and

California tidelands. *Where will federal waters stop?*



Justices Black and Burton. Tom Clark had been saved from appearing as attorney general in the case against Texas by appointment to the Supreme Court where he disqualified himself and sat out the case with Mr. Justice Jackson, who as attorney general had ruled in favor of state ownership. Justices Reed, Minton, and Frankfurter dissented. The latter stated, "The court now decides that when Texas entered the Union she lost what she had and the U.S. acquired it. How that shift came to pass remains for me a puzzle."

The puzzlement has spread rather than settled. Exactly where does federal control begin—at the line that marked low tide at the time the three states were admitted to the Union or at the present low tide? Must inland waters be completely surrounded by dry land of one state at low tide? Will other states lose their marginal seas, rivers, and lakes, one by one or only those fortunate—or unfortunate—enough to have oil deposits in their submerged lands? Can Congress legally pass a quitclaim bill that will give clear title over the lands to the states? How will the lands be administered? Will oil operations be the same under federal leases as under state leases?

There are answers to some of these questions and arguments about others.

Geographical Hedging

The property line between state and federal holdings, as the Supreme Court decisions stand, will be difficult to define. The continental shelf surrounds the continent and extends under the shallow seas for various distances before the land drops to the ocean bed. Geological history shows that the Gulf states were once almost completely inundated by Gulf waters. The lands now covered by shallow seas were once dry shores known to geologists as the Great Coastal Plains. It was the overflowing and receding of the Gulf in geological history that is believed to have created from marine life the oil and gas pools along the coast and beneath the sea. Geologically the shelf is part of the continent. In more immediate terms, it is geographical hedging. The bordering sea blossoms in peninsulas, islands, keys, and shoals floating among bays, straits, sounds, lagoons, and estuaries that respond to the ocean tides. One look at the coast line will tell you why the Supreme Court decisions clouded titles over wide areas. Louisiana may not need the extra 24 miles out to sea to have clear title to its lacy coastlands, but it needs plenty of room for title decision. Otherwise we are going to have court cases to clear title on every lagoon that is fed by the Gulf. Lands reclaimed from the sea must also bear some clear property ownership.

According to Attorney General McGrath, only the "tidelands" (the name sticks) where oil or something "important to national defense" is found will be claimed by the federal government. So the states that lease submerged lands for sand and gravel, pearl beds, oyster beds, various metals, salt, seaweed, etc., are, according to this opinion, safe for the moment in their property rights. Only if oil or something "important to national defense" is discovered, will the submerged lands forthwith be taken by the U.S. government.

Yet Governor Warren of California, whose state gets about $3,000,000 a year in royalties, stated: "So far as my state is concerned, the oil issue is a minor one compared with its other fundamental rights, which are infringed. We have 1200 miles of coast line . . . oil deposits are under only 15 miles . . . Our great concern is not that we may lose some oil revenue but that our dominion over our tidelands for every purpose is clouded."

So here we have some states deprived of their territorial sea because of what the subsoil contains or is believed to contain; others presumably are to continue enjoying their submerged property. Citizens of the deprived states assert this is less than "equal footing." Who makes the decision as to which states are to be sued and whether the McGrath statement is a final decision is not known.

All these actions and pronouncements shake down into what must be

Pipeline right-of-way, Mississippi River delta. *Louisiana's lacy coastline.*

the basic purpose behind the tidelands controversy. Executive officials of the federal government, including the President, feel that they need and must have control over more oil resources. This is an ambition that is shared by other governments. Several have expropriated all oil resources—Iran is an example—and in other countries oil development, along with other industry, is capitalized and managed by the central government, as in the USSR.

Government Oil Projects

The U.S. government first turned its attention to oil supply in 1906 when the Congress decided to build four new battleships and the question was raised whether they should burn fuel oil or coal. Geologists of the Department of Interior said our petroleum supply would last 20 years, from which it can be calculated the total oil reserve estimate was approximately the same as our present annual consumption.

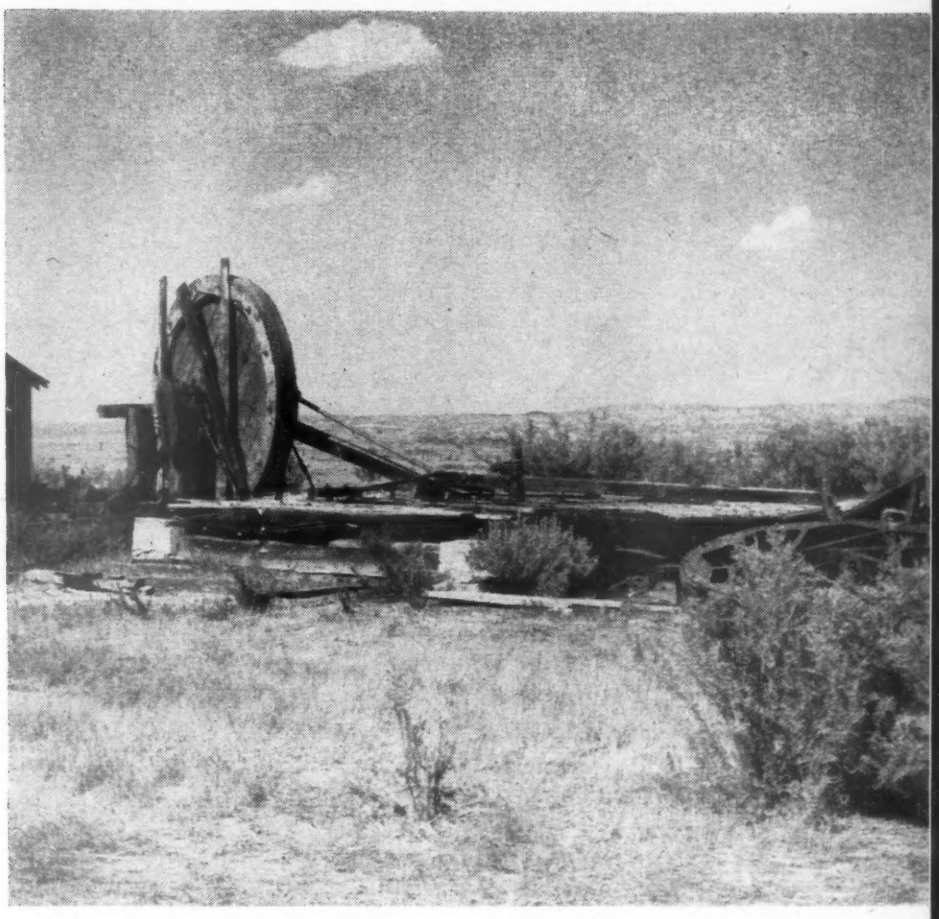
The battleships were to last longer than 20 years and we were told we would run out of oil before we got their full use. Congress nevertheless decided the ships should be powered by fuel oil and added a proviso that the oil for them must be assured.

The assurance came several years later in the form of the Naval Petroleum Reserves. Two geological structures were selected in California, one in Wyoming (Teapot Dome), and one in Alaska, where the oil for the Navy was to be preserved underground for use in emergency.

There were two things wrong with this apparently sound idea. First, oil and gas do not necessarily remain in a neat pool. Like water and animals, oil and gas are subject to the rule of capture because they may escape or they may migrate from one part of a structure to another.

Second, underground oil cannot be used in an emergency. It sometimes takes years to locate the oil sands and other years to develop them to full production. Generally people think of oil wells as a flash in the pan but actually many wells are long lived. There are several today that have been producing about 90 years.

As far back as 1924 Admiral Robison said the only oil the Navy could call on in an emergency was oil immediately available at the bases. Oil left in domes in California and Wyoming hills, he calculated, would not be a factor in an emergency of hostilities though it might help us pay a tribute imposed by some conqueror as a result of a war in which we had been unsuccessful because of want of preparedness in the matter of fuel oil.



Teapot Dome Reserve. *The atrophying effect of government control.*

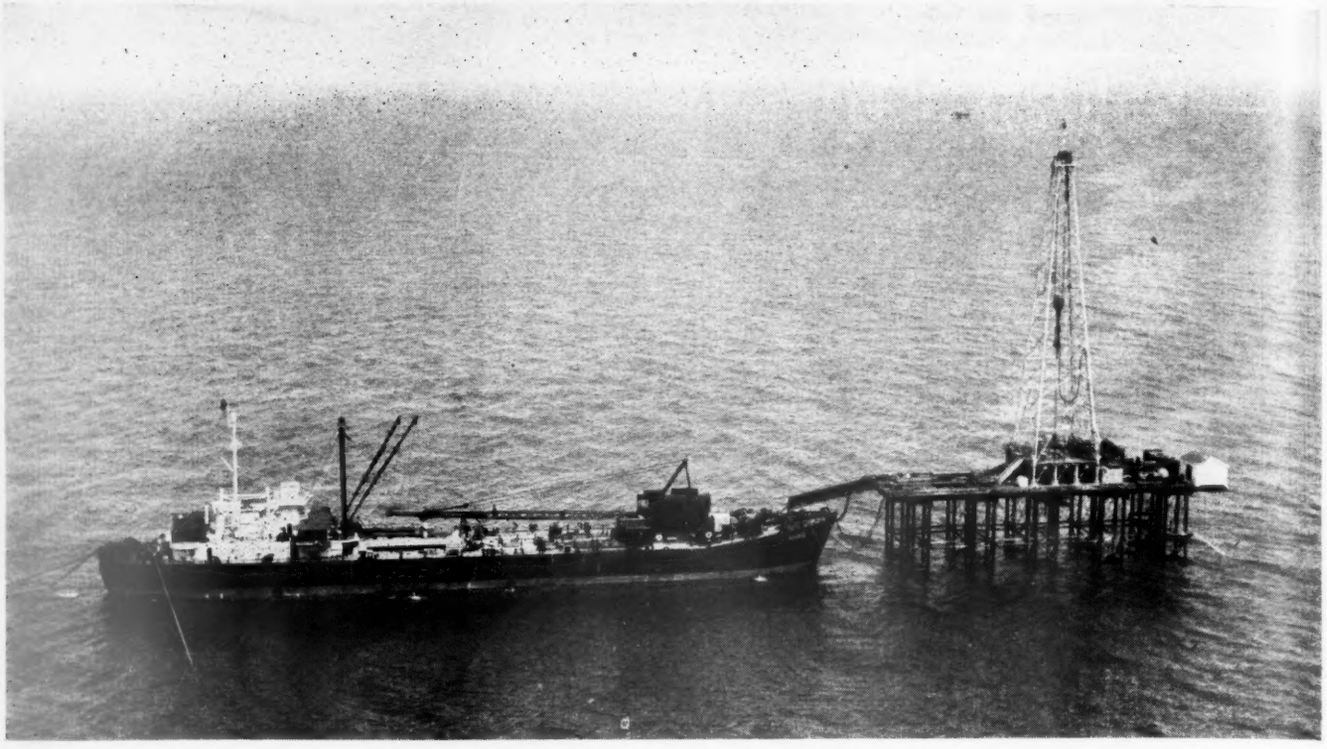
When Uncle Sam finally agreed with this view and leased the Naval Petroleum Reserves, the result was the so-called "Teapot Dome" scandal. The leases were all right, more favorable to the U.S. than those of today, but the court declared them fraudulent because of the method of obtaining them. There is not space to go into the oil scandals of the 20's but the recent Reconstruction Finance Corporation investigations will give you an idea.

But the important thing you want to know is—when emergency came did the Naval Petroleum Reserves provide Uncle Sam's ships with oil? Actually they contributed so little that some believe they are a liability. During World War II the NPR's produced 7000 bbl a day, a fraction of one per cent of the amount used by the Armed Forces. The oil cost more than it could be purchased for, especially considering the use of valuable Naval personnel, who supervised the oil companies' supervisors, and the scarce materials and labor that had to be poured into the project to develop the fields quickly.

The Naval Petroleum Reserves were honestly conceived but their history demonstrates the virtual impossibility of developing oil resources by government edict.

If the federal government plans to handle the subsea lands it has acquired off California, Louisiana, and Texas as the NPR's have been operated, it should be understood that both recovery of oil and profits are questionable. In 1950 Congress allowed $12½ million to run the Naval Petroleum Reserves. Expenses were $17 million and royalties brought in $2½ million. Some of the money spent was investment capital, like the exploration work in Alaska. NPR No. 4 in North Alaska has cost more than $38 million for oil exploration, which has not been successful, and has now been discontinued. Is there oil there? Geologists who should know say so.

There is no accurate way of figuring a balance sheet on the NPR's program from the time of their establishment. Approximately a third of the proceeds resulted from litigation over the Teapot Dome and Buena Vista contracts, which one trusts will not be a recurring income. Also Naval men in charge are not paid by the project but by the Navy. As it stands the balance sheet is another of those bits of plastic financial reports that can be distorted to many proportions.



Off-shore Drilling, Louisiana. *Will operations be the same under federal leases?*

The federal plan for operations of the marginal seas proposes that the submerged lands can be set aside as reserves, or can be explored by federal agencies, or can be leased to private industry. It is stated that the purpose of providing for these reservations is to enable "husbanding of petroleum underground for future military use."

You know that looks good on paper just as it did in 1910. I could still fall for it even though I know better. Take the Alaska Naval Petroleum Reserve No. 4. The oil prospects seemed so attractive up there on the north shore that private companies were thinking of taking the big risk of exploring in the Arctic region when the government stepped in. The Geological Survey of the Department of Interior advised exploratory drilling in 1923 when the area was withdrawn for an oil reserve; but Congress did not appropriate funds and no action was taken. Any oil company or companies, with a lease over the area, would have been forced to drill or get out and let some one else drill. If private companies had been allowed to enter the territory competition would have spurred them to a thorough exploration long before Pearl Harbor and we would have had oil production or an idea of the prospects.

But Alaska was not explored and the need for immediate fuel for Far North military forces during World War II took Uncle Sam into the expensive Canol project. The result of that federal experiment in the oil business was $150 million dollars for one millions barrels of oil. The cost wasn't only the dollar loss. There was the cost of an army of Army Engineers badly needed everywhere, the cost of materials and labor no less in demand.

Public Domain Oil Development

Outside of the NPR's, Uncle Sam already owns one-fourth of the land in Continental United States, which he can lease for oil and gas exploration and development. This is called the public domain. Most of it is in the western states where there are great geological basins that indicate oil deposits. Congress passed an oil and gas leasing act in 1920 so that these lands could be leased for mineral development.

You want to know how Uncle Sam has made out on this deal? Not good. Owning a fourth of the land, Uncle Sam's public domain squeezes out 4 per cent of our domestic oil production while three-quarters of the continental U. S., privately owned or owned by the states, comes up with 96 per cent of the production.

If anything, the public domain has proportionately greater oil potentialities, so how do you figure that happens?

One reason is the federal lease. Leases on public domain are low in cost; state leases are generally higher because they are auctioned to the highest bidder while federal leases are usually non-competitive, awarded on a first-come, first-served basis unless there is already oil development in the area. The expense of a federal lease, however, is hidden in red tape. Take one instance: A small oil concern had to plug a dry hole it had drilled on public domain in New Mexico. The driller notified the federal agent, who promised to be on hand to make the inspection. The agent went on a fishing trip, didn't get back in time, and when he did return he notified the driller he would not be out but to go ahead and complete the plugging.

In the 24-hour delay, the driller was paying $25 an hour for plugging equipment, was paying an idle crew (wages are the biggest expense in drilling), and he was delayed on his next job.

It would take volumes full of incidents to picture the atrophying effect of long distance federal control. There is an earnest endeavor to understand the operator's problems on the part of most field men and agents of the U.S. offices scattered over the leasing territory. There is the over-shadowing fact, however, that the real landlord is in Washington barricaded behind a multiplicity of rules and regulations, guided by changing politics and policies, unable to cope with the even more drastic changes in oil industry

operations, and indifferent to the individual's struggles to fit his operations into the rigid pattern prescribed.

Not long ago a news dispatch related that Russia had sent her satellite, Albania, some rigs to develop the nation's oil fields. The new rigs had a 4000-ft drilling capacity but the oil sand to be reached was 6000 ft deep. Is it any wonder the Communist world with the greatest potential oil reserves produces only 6 per cent of the world's oil and the free world 94 per cent?

This is an extreme illustration of the far-off landlord. The U.S. government does not supply rigs. It does, however, provide the exact conditions of drilling and producing operations, which can sometimes be as disrupting as the wrong size rig.

How do we know? We don't have to conduct a poll. There were 43,000 wells drilled in the U. S. in 1950; just two per cent were drilled on public domain although it comprises some 24 per cent of the total area and has great potential petroleum lands.

The small operator who goes in for wildcatting finds most of the oil found in the United States. He'd rather deal with an individual or a state; he hates to get tangled up in all that small print in a federal lease. If you've come under the recent price controls you can see why he'd rather drill in a not-so-promising spot and stay out of the long-distance landlord's red tape.

If the federal government has realized any net revenue from its control of oil and gas leases on public lands in continental United States and Alaska, the amount is hard to determine. In 1950 about $27 million were received for leases, royalties, and bonuses. This was the second highest amount ever collected in one year but expenses of the bureaus in charge consumed this and more. There seems to be no way of calculating with any accuracy the cost of this particular phase of their work.

The Commissioner of the General Land Office in 1863 said, "It is not the design of Congress to look to the public lands as a source of direct revenue."

Recent administrations have held the opposite theory—that public lands should produce direct revenue. Under either theory the whimsical hand of political government produces the same result—no direct revenue.

Judging by past efforts, none of the methods by which Uncle Sam has administered prospective oil lands are attractive from an oil-producing or from a revenue-producing viewpoint.

The Naval Petroleum Reserves illustrate two methods of development. The Alaska project was managed directly by the federal government, as was the Canol project. The other NPR's are leased to oil companies but supervised by Naval personnel.

The 40 years experience in handling NPR's under either system is unsatisfactory. To extend either method to marginal sea is to expand failure and to set up on a grand scale a breeding ground for political scandal. The oil scandals of the past might not be repeated but the means for even greater ones would be placed temptingly within the grasp of political appointees. There have been occasional efforts by the Navy to get rid of one or two of the NPR's but Congress has refused to allow them to be turned over to the Department of Interior, evidently because of the old oil scandals.

If the same type of control is used that is now exercised over public domain, oil development in the marginal seas will be slow and revenue will be small. For 30 years the federal government has controlled oil operations in the continental United States and Alaska public domain, and returns have been some $260 million, or less than $9 million a year, hardly enough for the maintenance of the several bureaus with a hand in the operations and the 15 to 20 offices where leases may be filed.

The $40 Billion Dream

There is a great deal of rosy talk about $40 billion dollars by those favoring federal control. This is based on an estimate of 15 billion barrels of oil in the submerged lands of the Gulf of Mexico.

First, we haven't found the 15 billion barrels or anything resembling that volume and oil keeps right on being where you find it. Geologists have been as enthusiastic about possibilities in North Alaska as about those in the Gulf but the federal exploration project hasn't revealed just where it is in Alaska and no outstanding fields have been proved so far in the Gulf.

Prospects for petroleum in 800 million acres of public domain are as good as or better than they are in the 8 million acres of marginal sea taken over by the federal government, and certainly drilling operations are much easier, yet in 30 years this public domain has produced only slightly more than one billion barrels of oil. At this rate, considering only production, it would take longer than 400 years to produce the 15 billion barrels of oil. It might also require more than $40 billion to develop and produce the reserves.

The $40 billion seems to have about the same substance as the convincing promises of the blue sky oil promoters of early days who scorned actually to drill for oil.

It is safe to predict that the U. S. treasury will obtain more revenue from an oil industry that is developing reserves in the adjacent sea with the authority of state leases than it will receive from restricted federal development under any procedure that has so far been tried. Undoubtedly we would have more oil production under state leases, which promote exploration and development.

If Uncle Sam expects to "husband petroleum underground for future military use" as proposed, the marginal sea is hardly a suitable location, being the most exposed area imaginable in this age of submarine warfare. It is a section that must be completely developed in peacetime and equipped with well concealed production facilities for use in event of war.

In view of the fact that so far the federal government has been uniformly unsuccessful in its oil projects, from the standpoints both of producing oil and of producing revenue, it is surprising that some Washington officials are so determined to enlarge federal oil operations. It can only be concluded that these officials believe development of oil resources is secondary to development of federal power. That seems to be the only answer to the case of the "tidelands."

To the President and the Congress the choice now lies between adding to federal power or adding to our oil reserves.

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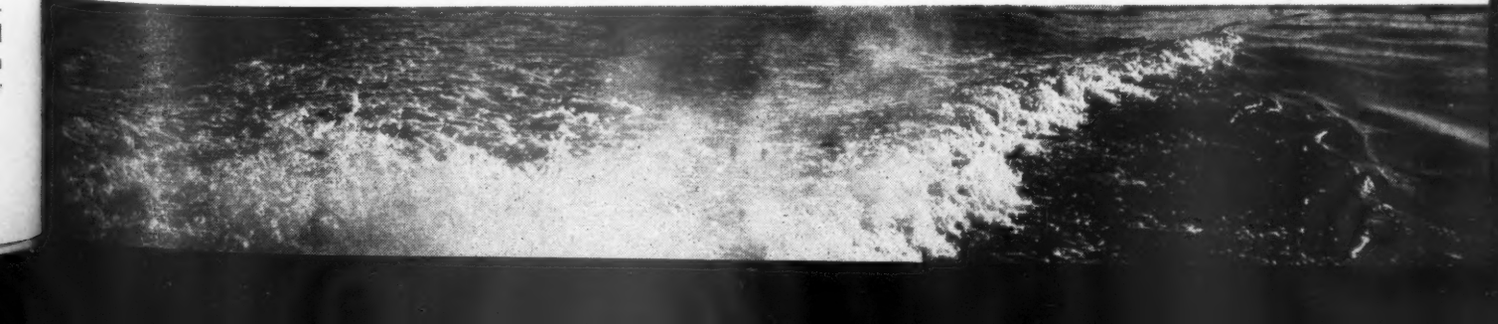
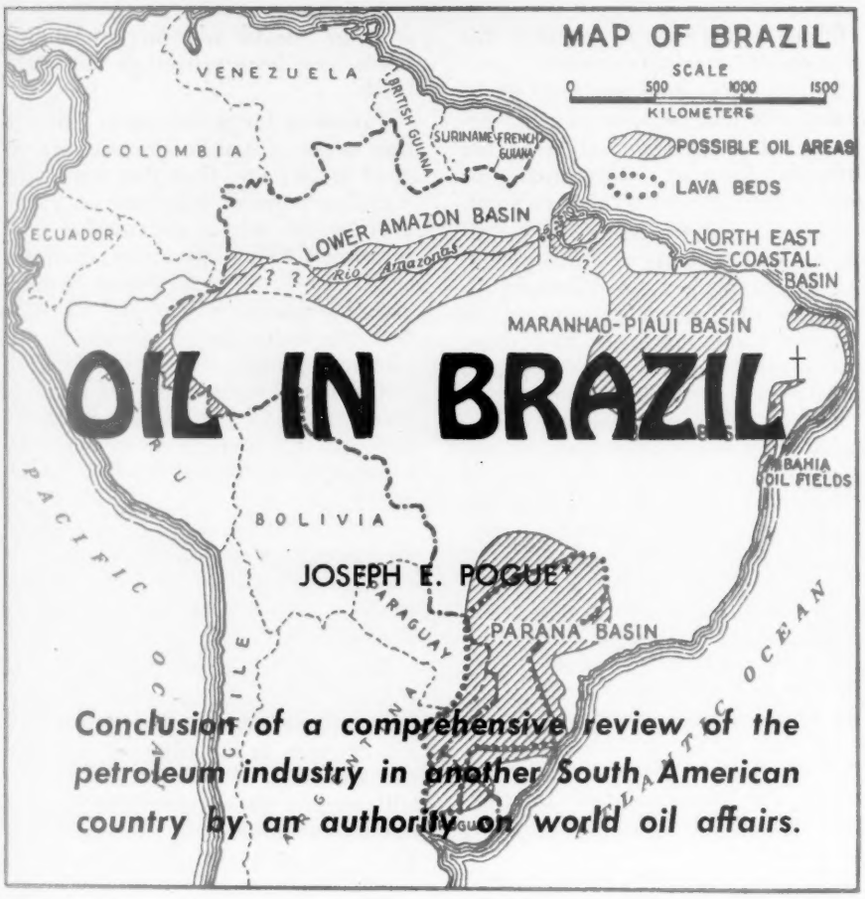




OIL IN BRAZIL†

JOSEPH E. POGUE*

Conclusion of a comprehensive review of the petroleum industry in another South American country by an authority on world oil affairs.

PART 3
A Design for Oil Development in Brazil[6]

The story of oil goes back to ancient times. History makes repeated reference to the solid residues gathered from oil seeps; the "eternal fires" of ancient Persia became the basis for religious worship. Even Noah is reported to have waterproofed the Ark with a lining of pitch. Thus oil may be said to have begun its useful career by furthering the escape of man from the elements and it is now opening the third dimension to his release from the limitations of time and space. On every side we see the "wings of petroleum," the symbol of a new age.

As an industry oil is young. Its birth was about 90 years ago. "Discovered" almost simultaneously in the United States of North America and Russia, oil in the two countries followed at first parallel but eventually divergent courses. In each, exactly 30 years elapsed before production attained a level of 100,000 bbl daily. For three years, 1898-1901, Russia actually exceeded the United States in oil output. Then the two paths diverged. Russian production did not regain its 1901 peak until the lapse of nearly three decades, hampered as it was by strikes, riots, religious warfare, the imposition of prohibitive royalties by the government, and finally by nationalization. In the meantime, under the drive of a sustained incentive, the United States forged ahead in continuous expansion so that today the output of oil in the United States is over 8 times that in the older country.

This initial parallelism and subsequent divergence emphasizes and contrasts two ways of action—the individualistic and the collectivist. For many decades the motivations surrounding oil were not too unlike in the two countries, but around the turn of the century conditions changed. In the United States, individual enterprise continued to be encouraged; in Russia, there was progressive interference by the state and eventually this agency took over entirely.

Oil Is Important to Brazil in Two Dimensions

Oil is important to Brazil in two related but entirely different respects. First it is a very mobile and convenient form of energy whose utilization pervades all phases of industry, commerce, transportation, and agriculture. As such its increased availability will serve to expand these activities, acting as a sort of lever or catalytic agent. Therefore oil is not merely a desirable commodity; it is an economic force of the first magnitude. Standards of living are closely tied up with the *per capita* consumption of oil.

The second way in which oil concerns Brazil lies in the possibility of finding and developing substantial oil fields within its own borders. This aspect is entirely apart from the matter of maximizing the utilization of oil, for which the requirements can be met from abroad. The development of domestic oil production adds a new dimension. It creates a new industry, increases the number of jobs, leads to the construction of roads, improves the exchange position in international trade, enlarges buying power and consumption, and in general brings about a net advance in a large number of wealth-creating factors. Therefore it is advantageous, especially in a developing country, for oil to be produced in sufficient quantity to stimulate domestic activities and provide a surplus for export.

Integration Is an Indispensable Principle

The consuming and producing aspects of Brazil's interest in oil may serve to identify and emphasize a great principle that characterizes success in the development of a petroleum industry. Reference is had to the form of organization known as integration. In this type of economic arrangement, the functions of exploration, production, transportation, refining, and distribution are linked in a single, continuous process like an assembly line. Integration is essential as a pattern for the oil business for the reason that every step in the process from geological exploration to the delivery of products to the consumer is highly specialized, must be conducted in conformance with the liquid form of the substance, and cannot be carried on by the existing facilities of other industrial and commercial undertakings. Therefore, when free to develop, the oil industry tends to become a vertical enterprise, cutting across the stratifications of an economy and extending laterally beyond the confines of political frontiers.

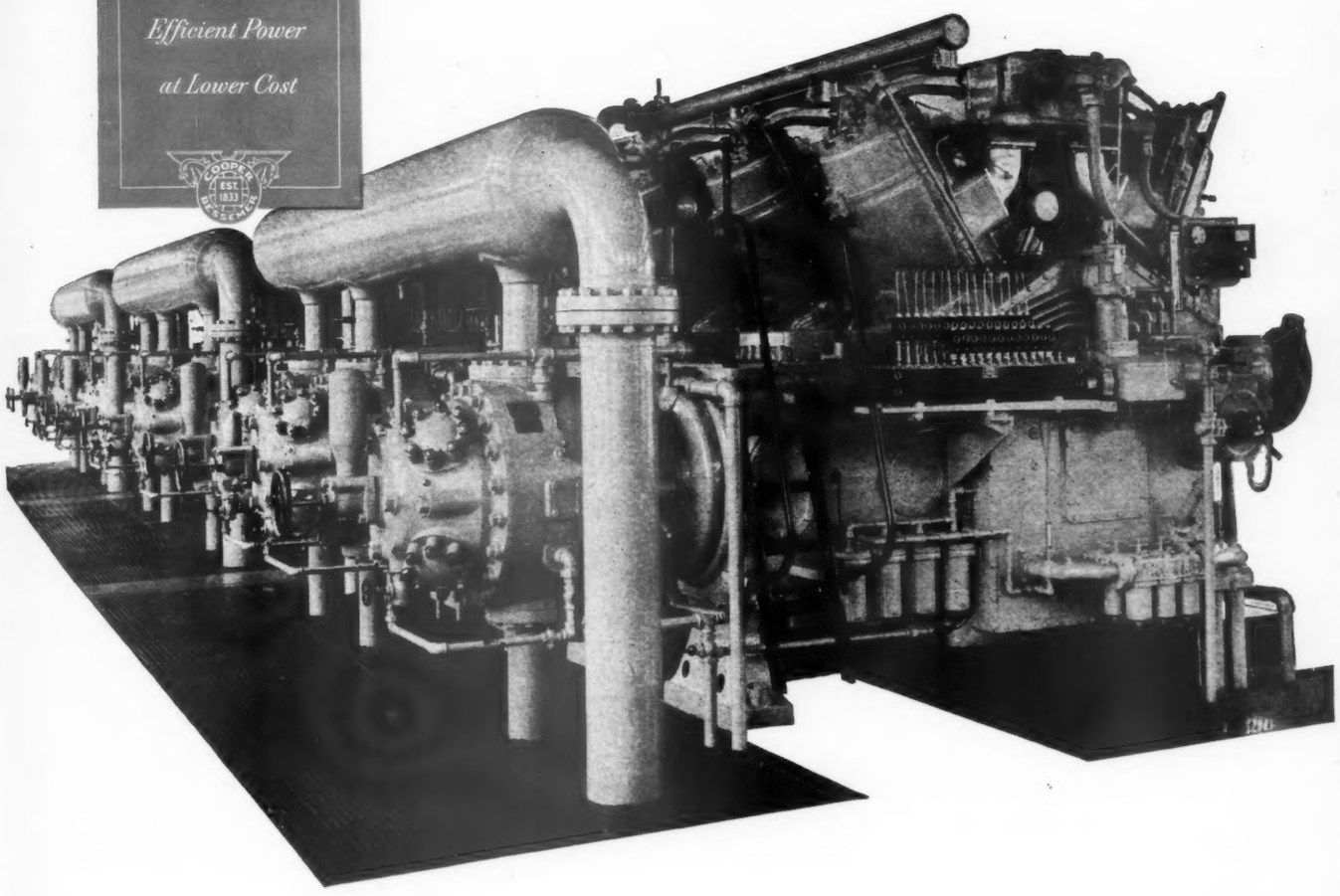
Integration was a natural evolution in the petroleum industry. Such an end-point was inevitable because of

†Reprinted from a booklet published by the Chase National Bank of the City of New York. Parts 1 and 2 are published in The Petroleum Engineer, August, 1951, Page A-43.

*Petroleum consultant, Chase National Bank of the City of New York.

[6]When in Rio de Janeiro in April of this year I spoke before the American Chamber of Commerce on the subject of Oil in Brazil. As this discussion attempted to outline a pattern for gaining optimum oil developments in that interesting and rapidly expanding economy, the address is reproduced in full as Part 3 of the present study.

Another Example of Efficient Power at Lower Cost



How to trade engine heat for cold cash!

IF you're a technical man, you know that an engine simply converts the heat of fuel combustion into usable motion or power. You also know that there's always *unused* heat that must be dissipated or somehow disposed of. In sizeable engine installations this can be a big problem, involving lots of costly cooling equipment and valuable space.

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the liquid nature of petroleum and the competitive urge for operating economies, which through a process of adaptation brought about the industrial pattern best suited to the job. The integrated form is revealed, too, in the corporate structure of the typical American oil company; and although a large number of units exist that operate in only one division of the business, these entities subsist and thrive in the network of the integrated pattern and, I believe, only by virtue of it. In a country of advanced oil development such as the United States of North America, integration is a prime factor in promoting efficiency and cost-reduction, thus enabling the industry to serve the consumer with lower-cost products than would be possible without this arrangement.

In importing or exporting countries such as Brazil or Venezuela, integration offers an additional advantage by promoting the international flow of technology and capital, by bringing markets and supplies into closer contact, and by facilitating the movement of oil across political boundaries. Only organizations of international scope can possess the type of integration effective for these purposes. By its very nature, state enterprise cannot provide an equivalent. In consequence, no country seeking to promote oil production and consumption within its boundaries can afford to rely exclusively upon its detached efforts for the best results, irrespective of its competence in the field of industrial development generally. As soon as an oil problem transcends the geographic limits of the state (and what important problem in oil does not?), then its solution involves *ipso facto* the element of integration.

Early in 1949 I gave a talk in Toronto in which the discussion centered around the outlook for oil developments in Western Canada. Even at that time, it was possible to be quite optimistic about oil prospects in Canada and there was painted in bold strokes a picture of expansion that was most pleasing to the audience. One could anticipate a great oil future for that country because it possessed a hunting ground of favorable geologic character covering a half-million square miles, the government had undertaken to grant prospecting and development rights to all qualified applicants, the principles necessary for the establishment of a competitive, integrated oil industry were recognized and approved, and large markets were either available or could be established. In a word, the opportunity was present and incentives to vigorous effort were in action. Accordingly I felt justified in the statements that "it requires no stretch of the imagination to picture the Canadian potential as 5 to 10 billion barrels, or even more"; and "it would be reasonable to expect Canada's production to match its consumption within 10 years," that is, to be 400,000 bbl daily by 1958. In the light of subsequent events both predictions might be regarded as conservative, for in the two intervening years a billion barrels of oil have been developed, production has risen above 100,000 bbl per day, a pipe line has been completed from Alberta to the Great Lakes, and the Prairie Provinces are now characterized by an oil boom second to none in the world today.

Brazil Faces a Difficult Problem in Development

One cannot be equally assuring about the imminence of important oil developments in Brazil, although it has a large area of sediments in which oil may be found — over 750,000 sq miles in fact. And this area may contain important oil resources. But there are many handicaps that much of the Canadian hunting ground does not possess. Brazil's geology is more obscure and much less known; the sedimentary basins for the most part appear to be quite thin, a serious handicap to major oil occurrence; much of the territory is covered by almost impenetrable jungle, or by extensive lava flows, or lies in country difficult of access; and the costs of exploration and transportation are extremely high. These considerations place the oil of Brazil in a less available position than is true for many other areas of the world. Accordingly more time, effort, capital, and inducement must be provided for its development than otherwise would be necessary. Tens, if not hundreds, of millions of dollars and one, if not several, decades of time might be proper measures of what may be required to get the answer.

In the meantime oil products are available from the Caribbean area, because substantial refining capacity is in existence there and the European market for these products has been shrinking under the impact of shipments from the Middle East. Even though commodities must be exported in exchange for this imported oil, the process promotes the expansion of trade and creates purchasing power in the hands of the suppliers for increasing, in turn, the export markets for Brazilian products. The most immediate objective is to facilitate the balanced growth of internal oil consumption to which end maximum utilization should be made of existing facilities, whether national or foreign. Such a policy will create, with minimum sacrifice of growth in consumption, the time required to bring about adequate exploration for local sources of oil supply and under certain conditions even help provide the funds for financing the effort. And should full success in discovering local sources of oil supply fail to materialize or be long deferred, Brazil will find itself more closely linked to the integrated pattern of the international oil trade with continuity of its external sources of supply better assured.

A General Misapprehension About Oil in the Ground

At this point permit me to clear up a widely prevailing misapprehension about oil in the ground. It is generally believed that oil is liquid gold, bringing riches to those who go after it, and that the franchise to seek it is an extremely valuable privilege. As a matter of fact, oil is a very elusive substance, difficult to find and interposing great risks in the way of its exploitation. In the United States, the landowner is usually happy to assign the oil rights under his property to specialists for the consideration of retaining a one-eighth royalty. In Canada there were several decades of fruitless and costly search, involving hundreds of wells and millions of dollars, before the discovery of the Leduc field provided the key to important results.

This misunderstanding regarding oil reserves indeed goes even deeper and involves the confusion of a mental image with a fact. Petroleum as we know it in commerce does not exist as such underground; what is present is a body of hydrocarbon material that can be converted into a marketable commodity only by a time-consuming process involving not only capital and technology but also a series of less tangible factors such as incentive, competition, political and economic climate, and many others. Thus oil in Brazil does not now exist (except the limited quantity already discovered); it can only be created by a touch of genius employing the accumulated technology of the ages and operating under a setting supporting the most persistent efforts. What is underground in Brazil is merely "neutral stuff" or "starting material." Many steps must intervene before that becomes "black gold."

Incentive and Competition Are the Prime Movers in Resource Developments

The discussion now brings us to a consideration of another great principle that underlies the development of a dynamic oil industry. This principle is made up of two elements—incentive and competition. For example, there is a job to be done. It does not get done in a vacuum. There must be

a reward for success and there must be rivalry. If the job is very big, very complex, and fraught with uncertainty as to whether it can be accomplished at all, then the inducement and the matching of wits must be proportionately great. Any form of organization must be set in motion by incentive, whether monetary, political, or merely an aspiration, but no type of organization can provide rivalry if it is alone in its field.

Adequate incentive and vigorous competition are peculiarly essential in the search for oil. Where competition has not operated, little oil has been found in the world—and much of that modicum may be attributed to the borrowed effects of competition operating elsewhere. Thus competition can exert a diminished influence across political boundaries even where its direct entrance is forbidden. This is why a monopolistic system can achieve results of a sort. But if competitive activity is deliberately sought and encouraged, then the great body of know-how accrued over the ages in the form of technology and embodied in the substance of capital becomes available as a dynamic power to make the most of any situation. And through the pattern of far-flung integration, the results of competition can be gathered from every quarter and brought to a focus on specific objectives.

Viewed as a whole, the oil business differs fundamentally from industry generally in that it requires a continuous and unbroken stream of new discoveries to enable it to maintain and increase the capacity to produce its essential raw material. If this is not done in a given consuming country, then that country becomes even more dependent upon the success of oil discoveries elsewhere and upon the promotion of those methods of economic organization best designed to achieve discovery results. No country can escape the international character of oil. Yet any country can retard its own progress and contribute to unsettlement elsewhere by failing to further the search for oil in terms of optimun endeavor.

Three Types of Organization Available for Oil Developments

Oil has been discovered and developed in the world by three types of organizations—the individual enterpriser, the business unit specializing in this field, and the national unit or state.

Part of the success of oil developments in the United States is the result of conditions which encouraged the activity of thousands of individuals in the search for oil. This type of activity was rendered possible by the private ownership of the subsoil that gave rise to small leaseholds which in turn multiplied the subdivision of effort, spurred competition to a high pitch, and stimulated a great diversity of approach. Also large business units have been no less active in the development of oil in the United States and, in fact, there has long existed a commingling of effort by the small and the large with great advantage to the economy. The small enterpriser contributed a unique vitality and diversification to the undertaking, while the large units brought the advantages of massive effort and integration to the problems of carry-through to the markets. As a result of the special contributions of each type, and the three-way competition engendered, the endeavors were transformed into outstanding levels of achievement.

Outside the United States, conditions generally have not favored the small enterpriser. The task was too big and could not be subdivided sufficiently. The bulk of the achievements in this field has been made by the so-called international oil companies—massive aggregates of capital and technology, performing an integrated series of functions, and driven by a ceaseless urge to expand the production and utilization of oil. If experience is any guide, this form of organized effort represents the most direct avenue to achievement in this difficult field.

Many countries, however, have attempted to develop oil through the medium of an arm of the state. This centralized pattern involves the principle of monopoly and therefore excludes the factor of competition. The drive and force of the competitive type of enterprise are therefore lacking. The state operation, of course, has many proponents and has the advantage of conforming to the political aspirations of large numbers of people. The results attained by this method, however, have not been conspicuously successful. Given time and the benefit of favorable evolution, its achievement may become more noteworthy, but as a system it possesses certain inherent mechanical and economic drawbacks which, irrespective of the knowledge and skill of the managerial personnel, can be overcome with difficulty, if at all. It is slow in application and therefore "wastes" that invaluable ingredient, time; it must be subsidized out of the internal economy itself; and it lacks integration across the country's borders which limits the channelling of surplus production from sources to markets.

Private Operation Does Not Weaken State Sovereignty

Let me now attempt to clear up one more misapprehension. It has to do with the status of national control under governmental versus private operation. The confusion on this point is widespread. A nation does not lose control of its resources when they are granted under concessions to private enterprise, whether domestic or foreign, for development. The power of the sovereign is still supreme. A concession is merely an instrument designed to induce enterprisers, operating within the framework of the laws of economics and the terms of the agreement, to convert starting material into finished, commercial products. It is important, however, that the arrangements be fair and in conformance with the business risks; and in the event of success following the investment of capital, technology, time, and energy, there should be assurance on the one hand, and confidence on the other, that the rules shall not then be changed to the disadvantage of the undertaking. In those instances where summary action has been taken by a resource country in violation of longstanding agreements, and sufficient time has elapsed to provide a record, the results have proved disadvantageous. There is always present the philosophy that it is a bad thing to have "profits" from operations going to anybody but the nation's government; and that it is particularly shocking if these profits go to foreigners, even when the foreigners have put up the capital and assumed the risks. This philosophy, I believe, stems from the failure to appreciate the great advantages that accrue to a nation from the contributions that outsiders can make to the economy. The free flow of capital and technology across political frontiers is perhaps the greatest consummation to be wished for in these troublous times, short of peace—and to the attainment of a peaceful world a greater economic contribution could scarcely be made than in this manner.

The Views of Practical Oil Men

Some two years ago I was a member of a committee of the National Petroleum Council, a body advisory to the Oil and Gas Division of the Department of the Interior of the United States. This committee was charged with the responsibility of suggesting "A National Oil Policy for the United States". It may be of interest to summarize the committee's findings, for they may have broader application than merely to my own country:

"A country's oil resources are best developed when all who are engaged in petroleum operations—its own nationals and those of foreign nations—compete on equal terms. Favored treatment of one group at the expense of another, state monopolies, or state competition in any phase of oil retard maximum development . . .

"Agreements . . . should provide to the companies . . . security of title to the property or rights acquired; managerial control of operations; the opportunity to make a reasonable profit commensurate with the risks originally assumed, and to form capital for expansion; and means for the prompt and fair settlement of disputes that may arise.

"Finding oil calls for the efforts of a great many people of different characteristics. Despite the development of scientific methods, a major factor in discovery is still the willingness of many individuals and competing industry units, exercising independent judgments, to take risks. The chances of finding oil are increased as more people are encouraged to accumulate and venture their capital on their own initiative.

"The participation by many . . .provides those multiple sources of initiative, imagination, and responsibility, out of which springs a great variety of discoveries and inventions, new ideas, and tremendous productivity.

"The competitive form of economic organization, by offering the promise of reward commensurate with contribution and efficiency, utilizes a motivating force for which no adequate substitute has been found.

A Final Reflection

In conclusion, may I repeat that judging from results the most direct and effective way to find oil and develop an expanding oil industry is to utilize the resources and skills of the experienced oil companies that have achieved conspicuous results in so many parts of the world. This type of organization employs those principles and procedures that have evolved as an adaptation to the needs of an exceedingly complex and difficult field of endeavor. The oil industry has its ability and experience to sell; a country's oil needs have something to seek. But, like Omar, the Tentmaker:

"I wonder often what the Vintners buy
One-half so precious as the stuff they sell."

PART 4

Reprise

In April, when in the great city of Sao Paulo, I had the pleasure of lunching with a prominent journalist, who is a believer in private enterprise. He said: "Where are Brazil's colossal oil reserves? The volume of oil found to date is actually very small, hardly sufficient to supply the states of Bahia and Sergipe. My country is incapable of solving her petroleum problem by herself. We should operate like the Canadians. There, more than 110 companies are exploring for oil. The Treasury receives the royalty and lets anyone engage in the oil business. Brazil permits anyone to plant coffee but balks at granting the same privileges for petroleum. Such a policy is ridiculous and sterile. Brazil will soon be spending $200,000,000 a year for its petroleum imports. The oil will be ours but the dollars will go elsewhere. What fabulous amounts in hard currencies will be drained from Brazil for the oil which we do not produce within our own frontiers!"

Following lunch, my host took me to an art museum in which priceless treasures were displayed in the most striking setting—old masters and moderns alike. I was especially attracted by four immense Gobelin tapestries depicting the flora and fauna of Brazil. One in particular presented a scene in the Amazon jungle with the animals of that region standing boldly in the foreground. Among them was a huge elephant with curved ivory tusks. "But," I exclaimed, "there are no elephants in Brazil!"

"I know that," he replied, "but the artist thought there ought to be and therefore he put one in!" * * *

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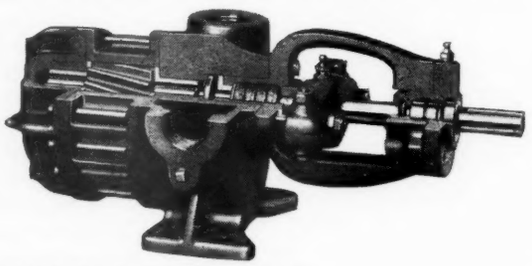

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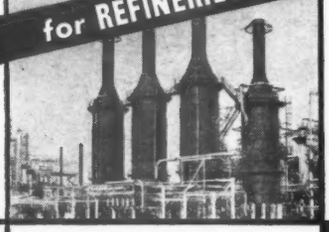

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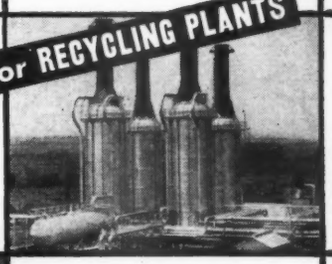

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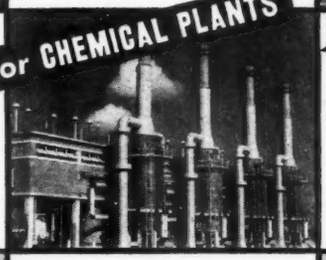

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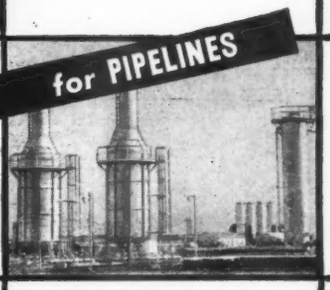

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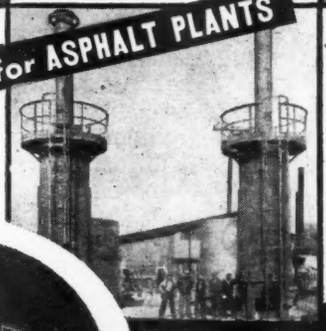

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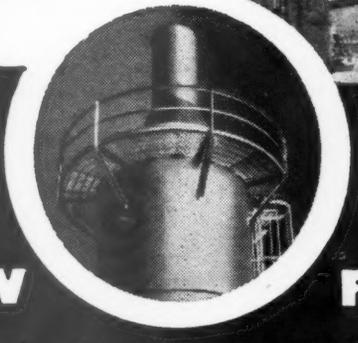

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Where Is All the Steel Going Today?†

Steel production has matched increase in industrial activity, but military needs will continue to cut drastically into output.

BENNETT S. CHAPPLE, JR.*

In spite of current governmental programs, D.O. "set-asides," and directed tonnages I suspect that among your many problems steel availability is never far from the top of the list. Many businessmen wonder why this should be so, for they hear from many sources that the steel industry has been, and still is, expanding and that we are producing more steel now than ever before in our history.

If these statements are true—and, of course, they are—then it is only natural that we in the steel industry should be continually asked on all sides, "where is all the steel going, and why is it, with more and more being produced, we find it so difficult to meet our share?"

I think you are entitled to an explanation. And, I also think that the explanation should answer your questions honestly and forthrightly — letting the chips fall where they may.

The outbreak of overt communist aggression in Korea on June 25, 1950, transformed the tone and tempo of American economic life. The first half of 1950 had been a period of energetic recovery from the mild recession of 1949. By mid-year, the production of goods and services had reached a new peacetime high and employment was nearing a record peak—a convincing demonstration of the recuperative vitality of a competitive enterprise economy. This recovery, like the recession preceding it, also had its counterpart abroad, particularly in Western Europe.

But after the start of the Korean incident there was a complete change in the setting. This country, and its allies, faced a clear necessity to rearm. For the indefinite future, it appeared, the "Western" nations must be prepared at the least for sporadic hostilities, and at the worst for a speedy mobilization to meet the challenge of total war. Thus, from July onward, the dominant economic problem in the United States became one of wedging an expanded military program into a productive machine already operating at practically full capacity.

In the 10 months that have elapsed since our complacency was jolted, we have found ourselves in a position without precedent. We are fighting battles in Korea, but we are not at war. We are engaged in widespread international trade, but we are not at peace. Like the sword of Damocles, a horrible threat to our way of life hangs by a slender thread over our heads, but we insist on business and pleasure as usual. We realize that the efforts we must make and are making to prepare ourselves and our allies against aggression will entail many sacrifices, but we hope that those sacrifices will not touch our personal pocketbooks today.

So, with simple faith that somehow tomorrow will solve tomorrow's problems, we go blithely forward, hoping that sheer volume alone may be expected to provide the solution to all our difficulties. We are turning out rifles and cannons and tanks and ammunition for the army as fast as we are currently able — and at the same time we have been pouring out huge quantities of automobiles and refrigerators and kitchen stoves and coffee percolators. We are building new military planes and guided missiles with unflagging energy — and at the same time we have been erecting new houses, new commercial and institutional buildings and building new arterial highways galore. We are making strenuous efforts to improve our logistics facilities primarily to make adequate transportation equipment available to the military if, when and as they should need it — and at the same time we have been expanding our output of electrical equipment, chemical process equipment, machine tools, materials handling equipment, television sets, and nylon stockings.

Under such circumstances, it is perhaps only natural to find industry in general bursting at the seams in some spots and lacking nutriments in others. Indeed, it is a bit of a surprise to our industrial friends in other lands to watch us go through a period like this without wholesale derangements in our economy. For actually, believe it or not, the truth is that less than five per cent of American industry's productive capacity up to now has suffered any serious difficulties in continuing to make and sell goods. True, many of these goods thus made and sold are quite different from what would have been produced normally. But so competent are American industrialists in the matter of accommodating themselves to changing needs, that very few of them indeed are finding it impossible to fit themselves and their enterprises into the new scheme of things, although this often entails a short period of maladjustment.

An automotive parts manufacturer, for example, takes on a subcontract for tank parts; a structural fabricator begins to make bailer bridges; an electrical appliance manufacturer gets a new lease on life making electronic equipment; a pressed metal jobbing shop contracts the making of parts for military planes. The point I would make here is simply that most American businessmen are adaptable. If they find the going is tough for the time in one direction, they veer off temporarily in another. And that is one of the reasons why American industry will always survive.

So much for the broad background. Now let's get down specifically to the problem of steel. I should like to make a brief comparison of two months in the recent history of the steel industry; June 1950 as a typical period immediately pre-Korean, and April 1951 as a period typical of today's situation.

In June 1950, the American steel industry produced a little more than 8 million tons of ingots, roughly equivalent to 5,850,000 tons of steel products. In April 1951 the ingot tonnage was approximately 9 million ingot tons, roughly equivalent to 6,570,000 product tons. Two factors explain the increase: a small increase in effective operating capacity, and a higher operating rate for that effective capacity.

In that one-month period, then ingot tonnage increased by 1 million

†Presented before the New York Railroad Club, New York, New York, May 17, 1951.
*Assistant executive vice president, United States Steel Supply.

tons and steel product tonnage by some 720,000 tons. And the question is, "where did it go, and why did not the increase relieve the situation?"

To answer that question intelligently we have to look at the over-all economic situation with respect to steel use in both of the months selected for comparison. The Federal Reserve Board index of industrial production for June 1950 stood at 199. (That means 199 per cent of the average for the years 1935-1939.) Preliminary estimates for April 1951 will probably be in the neighborhood of 224—an increase of 25 percentage points over June. Or, stating this in a simpler way, industrial production was somewhat more than one-eighth greater in April 1951 than it was in June 1950.

Now, if you will let your memories drift back for a moment to June of last year, you will remember that, industrially speaking, this country was going great guns. Automotive production was hitting a rate of better than 8 million units per year, all sorts of consumer durable goods like refrigerators and other household appliances were pouring out of the factories in rivers, building construction was moving forward rapidly, oil and gas pipe line construction was huge, industrial plant and equipment construction was rolling in high gear, railroads were struggling to rehabilitate their trackage and equipment, and other phases of industrial activity were also at practically floodstage.

Take this picture of rampant energy from your memory, and add to it another 12½ per cent, or an increase of one-eighth and you will have a rough idea of what April 1951 included. Then take the increase in steel production by 720,000 product tons from June of last year to April of this year and match it against the increase in industrial activity. This increase in steel output was exactly the same—12½ per cent or one-eighth!

So, on the face of things, it would appear that we should be able to say that the situation with regard to the supply of steel was no different in April 1951 than it was in June 1950; for the increase in steel production exactly matched the increase in industrial activity, and the distribution of all the steel products this year ought to match the distribution of last year.

But it doesn't. Where's the catch? Simply this: In June 1950 we had no Korean incident; in April 1951 we had an NPA in Washington allocating practically 50 per cent of our total steel output to certain very important uses either directly or indirectly related to defense needs.

We all realize, of course, that the needs for which such steel allocations or "set-asides" have been made are not all new. Right along some steel has been going into direct military needs, for guns, tanks, ammunition, airplanes, and so on. Some steel has been going to projects of the Atomic Energy Commission, for railroad freight cars, for pipe lines and for other uses definitely designated as programs. Furthermore, steel always has been distributed through warehouses for MRO purposes. However, if one takes all this government directed tonnage, which I have just said has up to now amounted to approximately 50 per cent of the steel industry's production, and compares it with the volume of steel distributed in June 1950 for similar purposes, without directives, we find a striking comparison. To somewhat oversimplify the description in order to make the comparison clear, let's call all these present requirements and their corresponding pre-Korea categories "defense," and everything else "civilian."

Then what we would call "defense" in June 1950 amounted to about 1½ million tons of steel products, or some 25 per cent of the total production of that month, while in April 1951 it equalled about 3¼ million tons, or almost 50 per cent of the total production.

Thus, as becomes evident from these rough figures, the "civilian" share already has decreased from about 4 1/3 million tons, or 75 per cent of the production in June last year, to some 3¼ million tons, or about 50 per cent of the production in April this year. In slightly less than a year, the "loss," as can be seen has been well over one million product tons per month. Furthermore, this loss unquestionably will continue to increase as the months go by.

Drilling Oil Well

Takes 76 Men

Drilling an average oil well requires the services and skills of 76 men, most of them specialists. The personnel which at one time or another takes part in drilling the average well is divided as follows: Workmen 16; truck drivers and helpers 10; rig builders 5; tool pusher 1; rotary drillers 4; rotary helpers 17; geologist 1; surveyors 4; petroleum engineer 1; electric logging crew 2; drillstem testing crew 1; sidewall coring crew 2; drillstem testing crew 2; casting perforation crew 2; mud logging crew 3, and cementing crew 3.

At this point, then, let me summarize the outlines of the situation as between June 1950 and April 1951.

1. Industrial activity and steel production both increased by one-eighth.

2. The steel controlled by NPA amounts to 50 per cent of production as compared with corresponding undirected pre-Korea usages of 25 per cent.

3. The steel available for all other uses today, including increased production, is actually over 1 million tons a month less than pre-Korea.

4. But in April 1951 the civilian economy was still at practically the same level of activity as in June 1950. In other words, we made practically the same amount of butter in both periods, but in the latter period we had added G.D.T.'s for D.O. and related programs accounting for double the amount of steel used in corresponding categories last year.

This, then, is the broad over-all picture up to now.

The National Production Authority, immediately after establishing the DO "set-asides" as a percentage of the product necessary for the armed services, established the number one formal program for supplemental defense by providing sufficient steel, starting in January, to produce 10,000 freight cars per month. This was allotted among all steel producers upon the recommendation of the steel "task force." Then NPA issued directives to the steel producers for the needed products, which have continued, as revised each month during the first half of this year, with the exception of the month of May, when the requirement was reduced to the tonnage necessary for 9000 freight cars. Total requirement of industry for freight cars for the first half of 1951 has averaged approximately 300,000 tons per month, with plates accounting for about 125,000 tons per month.

To give added impetus to this program, the steel producers were asked, regardless of glutted order books, to support this program by anticipating the formal directive and increasing December shipments on a voluntary basis. They did this to the extent of over 200,000 tons.

Each month directives issued by NPA to the mills have covered tonnage deemed necessary for contract car builders, railroad-owned car shops, and component parts manufacturers, and producers of fastenings were added in May. Commencing in April, NPA established a program to provide the steel necessary for building locomotives, which required a heavy contribution in plates.

The fact that plates represent so large a portion of the transportation requirements, added to those which

are involved in ship repair, maritime vessels, and well head equipment, has brought about a critical industry situation necessitating curtailment in other products to meet the plate demand. For example, the load of plates which United States Steel Company is committed to furnish for government directed tonnage during the month of June is equivalent to approximately 96 per cent of our plate shipments during January, when our shipments of this product broke all records in this commodity up to that time, except during World War II.

The fact of the matter is that, in addition to plates, NPA currently is directing the distribution of more bars than have ever been produced before. What this means is that the steel producers of this country at present are free to distribute only exceedingly small fractions of their output of these products for any uses other than those directed specifically by the government.

The net result of all this has been quite simple. Any consumer of steel who has had the foresight and good fortune to adapt his business to the requirements of contracts fitting within the purposes and objectives of directives issued by NPA—that is, for direct defense needs or any of the related programs—so far has had few worries about getting the steel he needed, because NPA issued the orders which directed steel producers to supply those needs. Beyond these categories, as you can realize readily today, chances to provide all the steel sought are slim indeed and undoubtedly will become slimmer as the defense effort expands.

Exclusive of M-6, which is the warehouse order, and M-1, the non-integrated steel converter order (also with the exception of line pipe, which we will continue to accept on a DO rating), new "set-asides," based on the original base period of nine months of 1950, are:

Structural shapes	75 per cent
Bars	45 per cent
plus 15 per cent for shell steel quality, or	
A total of	60 per cent
Reinforcing bars	55 per cent
Cold finished bars	50 per cent
Hot rolled sheets	60 per cent
Cold rolled sheets	40 per cent
Galvanized sheets	40 per cent
Hot rolled strip	25 per cent
Cold rolled strip	25 per cent
Rods	60 per cent
High carbon wire	60 per cent
Low carbon wire	50 per cent
Oil country goods	110 per cent
Pressure tubing	70 per cent
Rails and accessories	10 per cent
Wheels and axles	95 per cent
Wire rope	60 per cent

You will note that I have not mentioned plates. The reason is that plates are now set at 85 per cent, but they are to be figured upon a new and different base. I am advised that NPA's realistic appraisal of the plate requirements for the month of July exceed the current production of plates on the plate mills of the industry by substantially more than 100,000 tons. This additional tonnage therefore must be secured from sheet mills. This is merely another way of saying that the sheet percentage set-asides are actually much higher than the figures which I quoted, in terms of the actual sheet tonnage that will be left for civilian consumption.

This, then, is where the steel is going. I believe the days of eating our cake and having it too have passed. However, the danger is ever present that the pendulum will swing too far, for a sound military economy can be maintained successfully only if it is matched by a healthy civilian economy, however austere. In this emergency, which history may describe as one of the greatest in our peacetime experience, there is a real need for government and business alike to keep their heads, and to keep their feet planted firmly on the ground. * * *

INSTRUMENT SOCIETY HOLDS SIXTH ANNUAL CONFERENCE

The sixth annual Instrument Conference and Exhibit is being held at the Sam Houston Coliseum in Houston, Texas, September 10-14. The Coliseum is housing all of the approximate 229 exhibit booths. These booths are being utilized by 143 manufacturers, 4 manufacturer's representative companies, 1 trade association, 5 cooperating societies, and 2 educational institutions. In addition the U. S. Navy is occupying 10 booths and the National Bureau of Standards, 2.

Monday, September 10, is opening day for the convention, and the first session is on instrumentation for production processes. Other sessions deal with: Instrumentation for transportation, analysis instrumentation, instrumentation for testing, instrument maintenance and operation.

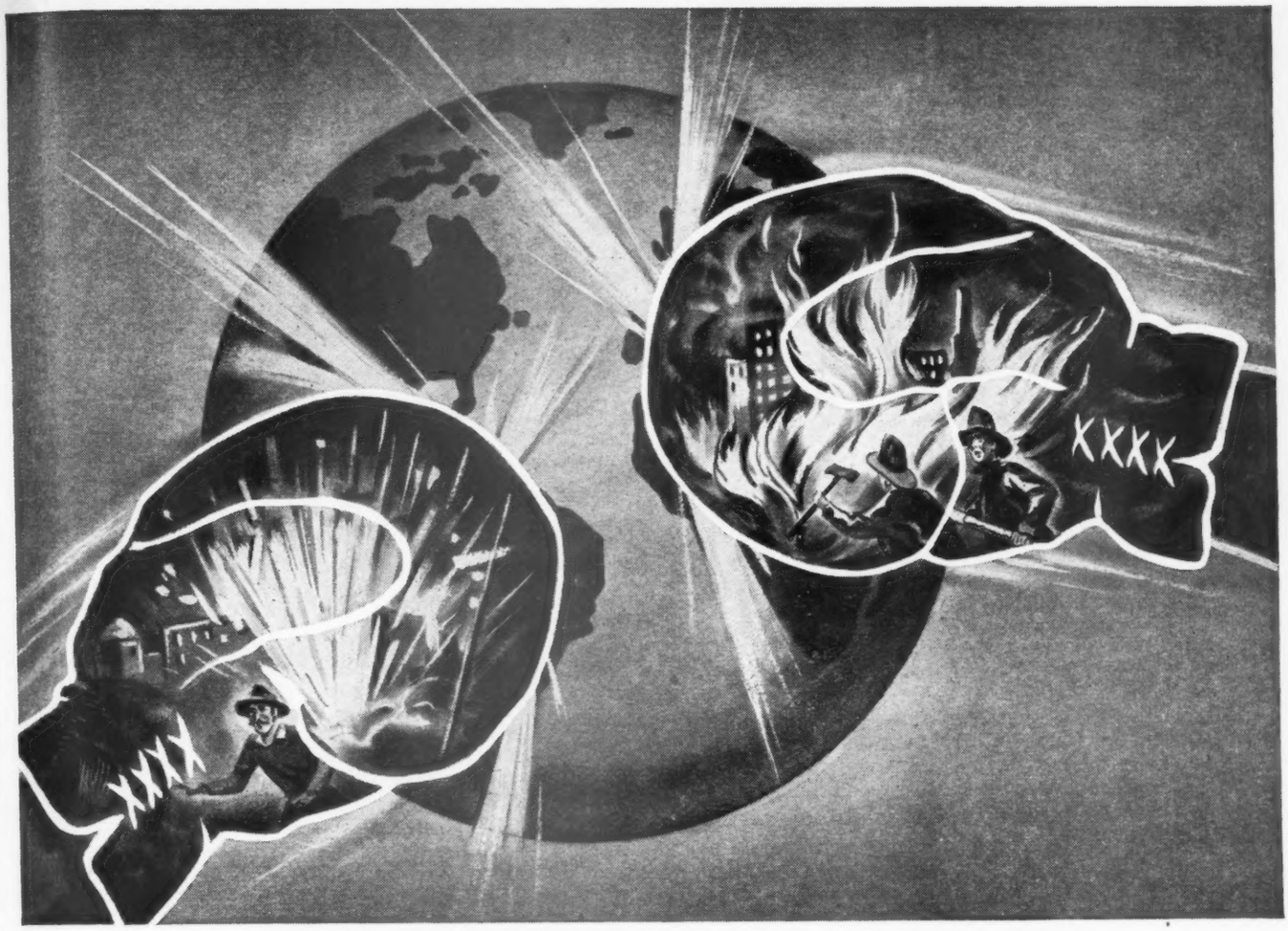
Many societies are taking part in the technical program. The IIRD of the American Society of Mechanical Engineers will hold a session on aviation instruments, geophysical instruments, and on the 13th, a Texas A & M symposium on instrumentation for the process industries will discuss measurement and analysis in control, transmission and control systems, and instrumentation application, in various sessions. The Institute of Radio Engineers is holding three sessions, along with the American Institute of Physics, AIEE Geophysical Technical Group, Gulf Coast Spectroscopic Group, the Pipe Liners Club, National Association of Corrosion Engineers, and The Armed Forces Technical Engineers.

The Instrument Maintenance Clinic was held September 7, 8, 9 prior to the conference and exhibit, the third of this series. The first was held in St. Louis, Missouri in 1949, and the second in Buffalo in 1950.

The participating companies, and the instructors are: Foxboro Manufacturing Company, Richard Hosmer and Robert Homfelt; Fisher Governor, Verne Hunt; Republic Flow Meter, G. E. Lintleman and G. F. Norwood; Brown Instruments, Elgin Lochte and Vern Miller; Manning Maxwell and Moore, A. J. Colonnese and R. J. Ingham; Moore Products, H. S. Garrett and W. B. Miller; Taylor Instrument, George E. Howard; Mason-Nielan, Paul Wing, Jr., G. R. Thomason, and Blair Powell; Leeds and Northrup, J. L. Sherrill, D. S. Lansdon, Jr. and J. E. Casey; and Hagan Corporation, Clayton W. Work.

National officers of the Instrument Society of America are as follows: J. B. McMahon, Republic Flow Meters Company, president, Chicago, Illinois; Porter Hart, Dow Chemical Company, first vice president, Freeport, Texas; Nelson Gildersleeve, General Electric Company, vice president, West Lynn, Massachusetts; N. L. Isenhour, Carbide and Carbon Chemicals Corporation, vice president, Oak Ridge, Tennessee; W. A. Wildhack, National Bureau of Standards, vice president, Washington, D. C.; G. R. Feely, Trinity Equipment Company, treasurer, Roselle Park, New Jersey, and Richard Rimbach, Instrument Society of America National Office, Pittsburgh, Pennsylvania, executive secretary.

Houston section officers are: R. C. King, Dow Chemical, president; C. R. Miller, General Tire and Rubber, vice president; I. K. Farley, Brown Instrument, secretary; R. E. Bailey, Taylor Instrument, treasurer; J. A. Parker, Shell Chemical, ISA director; M. K. Anderson, Carbide and Carbon Chemical, alternating ISA director; Roy O'Neill, Industrial Scientific, program chairman; J. R. Martin, Humble, constitution chairman; R. A. Barnes, Moore Products, membership chairman, and C. W. Braswell, Monsanto Chemical, publicity chairman.



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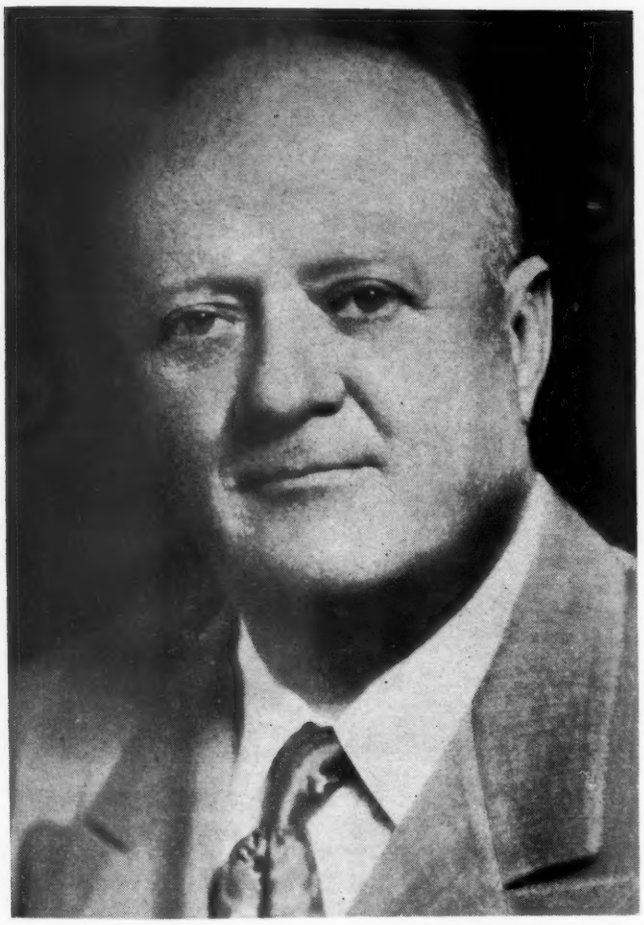


R. H. HARGROVE
President
Texas Eastern Transmission Corporation

IN 1900, after his mother's death, Reginald H. Hargrove moved from his birthplace of Marshall, Texas, to Shreveport, Louisiana. There he was raised by his maternal grandparents. The fact that his grandfather was for many years clerk and ex officio recorder for Caddo Parish had a pronounced influence on his life. In the course of growing up "in the shadow of the courthouse," as a lad he became conversant with legal terms, procedures and many other related matters which were to stand him in good stead in later years. But R. H. Hargrove did not spend all his time around the courthouse; his youth, in fact, was quite normal. In Shreveport high school he was an outstanding athlete, playing on the football, basketball, and track teams. After graduation from high school, he attended Rice Institute in Houston, studying engineering. In May, 1917, he entered the first officers' training camp at Fort Logan H. Root, Arkansas, and was commissioned a second lieutenant in the Coast Artillery Corps in August, 1917.

On his return to Shreveport, Hargrove was made general manager of the Caddo Abstract Company, and remained there until January, 1928, when he became associated with the land department of The Palmer Corporation, later a subsidiary of United Gas Corporation. From 1928 until 1937 he progressed through various operating affiliates of the United Gas Corporation.

In September, 1937, on organization of Union Producing Company, United Gas Pipe Line Company, and United Oil Pipe Line Company, subsidiaries of United Gas Corporation, Hargrove was elected vice president and general manager of these companies and in August, 1944, was also elected vice president of United Gas Corporation, parent company of the United Gas group.

Hargrove left the United Gas Corporation on March 1, 1947, to become associated with Texas Eastern Transmission, and on May 28 of the same year was elected president. Texas Eastern was formed to purchase the former Big and Little Inch lines, and did purchase those properties on November 14, 1947, from the United States Government for $143,127,000 at competitive bidding. So Texas Eastern was a big corporation at the beginning, and under Hargrove's guidance has continued to expand so that total capitalization today of the company is well over $230,000,000; and the company currently has underway an expansion program involving some $114,300,000!

Having been associated with the oil and gas business for more than 20 years, Hargrove has long been recognized as one of its leaders within the industry. He is a past president of the American Gas Association. After the close of World War II, he came to general public attention as a major spokesman for the natural gas industry during the Federal Power Commission Natural Gas Investigation. In rapidly assembling an efficient and aggressive organization for Texas Eastern Transmission Corporation, his genius for organization came to the attention of the Petroleum Administration for Defense. It was quite logical, therefore, that Secretary of the Interior Oscar L. Chapman, administrator for the Petroleum Administration for Defense, should call him to Washington to help organize and establish the gas division for that agency. Hargrove accepted the appointment on a temporary basis and served in Washington as the acting assistant deputy administrator in charge of gas matters during an organizational period from February 12 to April 1, 1951.

The administration of his company leaves Hargrove little time for outside activities, but he is active in civic affairs in Shreveport and serves as a member of both the Vestry and the building committee of St. Marks Episcopal Church. To these activities he contributes the same keen analytical mind and capacity for getting at the heart of problems that mark his work as an administrator in business matters.

A loyal Rice Institute booster, Hargrove enjoys spectator sports, particularly baseball and football. He has three sons, two of whom are graduates of Rice Institute and one a graduate of Texas University. (All three sons were in military service during World War II.) His sons, their families, and the six grandchildren occupy most of his leisure and weekend time, and it is not unusual for the Hargrove family to sit down on any Sunday with twenty-one places at the table, all for members of the immediate family.

How to Estimate Crude Oil Reserves By Decline Trend Method

Charts and formulas to make needed calculations much easier

R. W. CLARK, JR.*

ONE of the continuing assignments of the petroleum engineer is the estimation of crude oil reserves. Depending upon the purpose, the estimates are made on several different bases: By fields, pools, properties, individual wells, and selected groups of wells. The job is never complete. Changes in prices and costs affect economic limits; changes in operating methods and mechanical condition of wells affect production rates; new discoveries, new zones, redrills, and abandonments all contribute to changes in the picture. By customary practice, a substantial portion of the work involves tedious summation of hypothetical approximations.

This subject of reserve estimates has been described at length in the literature[1] and can be reduced to two general methods:

1. Volumetric methods.
2. Methods based on extrapolation of some form of production history.

It is the purpose of this paper to:

1. Analyze quantitatively the decline trend of production rate which is the most commonly used form of the latter method.
2. To present a workable method of estimating future production by the use of charts or formulae which eliminate much of the drudgery of summation.

The usual technique employed to estimate future reserves is to plot the history of production rate of a well or group of wells in such a manner that a trend is indicated. A projection is made to some economic or other arbitrary limit, and the production is accumulated for the period of time concerned. Depending on established trends, it is customary to project the production rate on one of two general bases:

1. Constant percentage decline rate, or as hereafter called "constant decline"; in which case the production rate is plotted versus time on semi-log paper.
2. Variable percentage decline rate, or as hereafter called "variable decline"; in which case the production rate is plotted versus time on log-log paper. In this case, a certain amount of adjustment to the time scale by cut and try method may be necessary before a straight line projection is made.

In the following work, the areas under these curves have been integrated to give remaining reserves; and a few conveniences have been added for rapid calculation. It is divided into four parts:

1. Estimate by rule of constant decline.
2. Estimate by rule of variable decline and discussion.
3. Adaptations of variable decline for supplemental use with constant decline and type problems.
4. Appendix, including derivation of formulae.

As this paper is addressed primarily to engineers who are interested in results, in so far as it has been possible to do so, all symbols, derivations, and formulae have been placed in the appendix. It is important to note that the following work is in no sense a "method," for the function of the charts is to serve merely as a slide rule. The tools that are presented, however, should prove to be of assistance to the experienced appraiser in solving the types of problems for which they have been designed.

The following terms are introduced and defined:

1. Rate ratio: The ratio of production rate with respect to two instants of time—usually the production rate at an arbitrary limit to the current rate expressed as a per cent.
2. Current barrel: The average production rate expressed in barrels per day as of the beginning of the period to be estimated.

For variable decline application only:

3. Current time: The value of time on the time scale on log-log projection expressed in years that represents the current month.
4. Time ratio: The ratio of value of time at the economic or other limit to the value of current time on the time scale.
5. Decline ratio: The ratio of final decline rate to current decline rate expressed as a per cent.

EXCLUSIVE

PART 1.

Reserve Estimate by Rule of Constant Decline

Type problem:

Given:

Net oil price = $2 per bbl.
Working interest = 80 per cent.
Operating costs = $200 per month.
Average monthly production rate in barrels per day as plotted in Fig. 1 and tabulated in Appendix C.

To estimate:

A. Economic limit in barrels per day.
B. Remaining economic life in years.
C. Remaining economic reserves in barrels.

Solution:

A. Estimate economic limit.

Chart 1 — "Economic Limit" relates:

1. "Net" oil price in dollars per barrel: (Price of oil plus revenue and minus costs that can properly be reduced to a per barrel basis.)
2. Working interest in per cent.

*Richfield Oil Corporation.
[1]J. J. Arps, *Analysis of Decline Curves*, Trans. AIME, 1945.

3. Operating costs in dollars per month. (Costs applicable on time basis.)

4. Economic limit in barrels per day,

as defined by equation 1.[2]

Thus: Apply first three assumptions from above in order given and economic limit = 4.1 bbl per day.

Note: The price and cost scales cover full ratio of 1 to 10. In this way, a price of 20 cents per barrel would yield 10 × the limit or 41 bbl per day. Likewise, a cost of $2,000 per month would yield 10 × the limit or 41 bbl per day.

B. Estimate remaining economic life:

In Fig. 1, a projection has been made to the economic limit of 4.1 bbl per day.

Chart 2 — "Economic life — constant decline" relates:

1. Production rate ratio,
2. Decline rate in per cent per year,
3. Remaining life in years,

[2]Appendix.

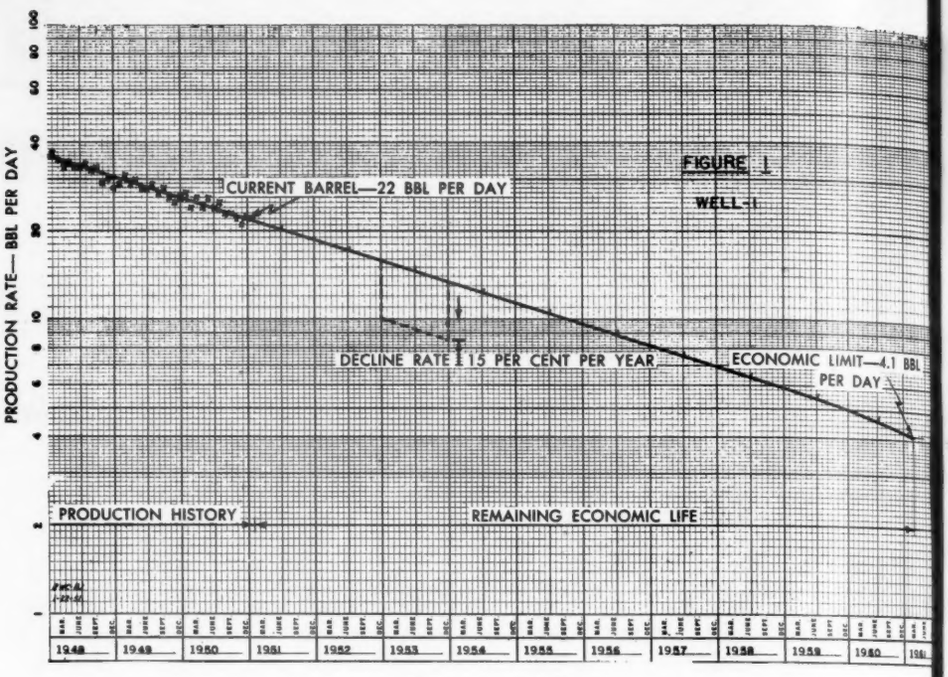


FIG. 1 — WELL 1

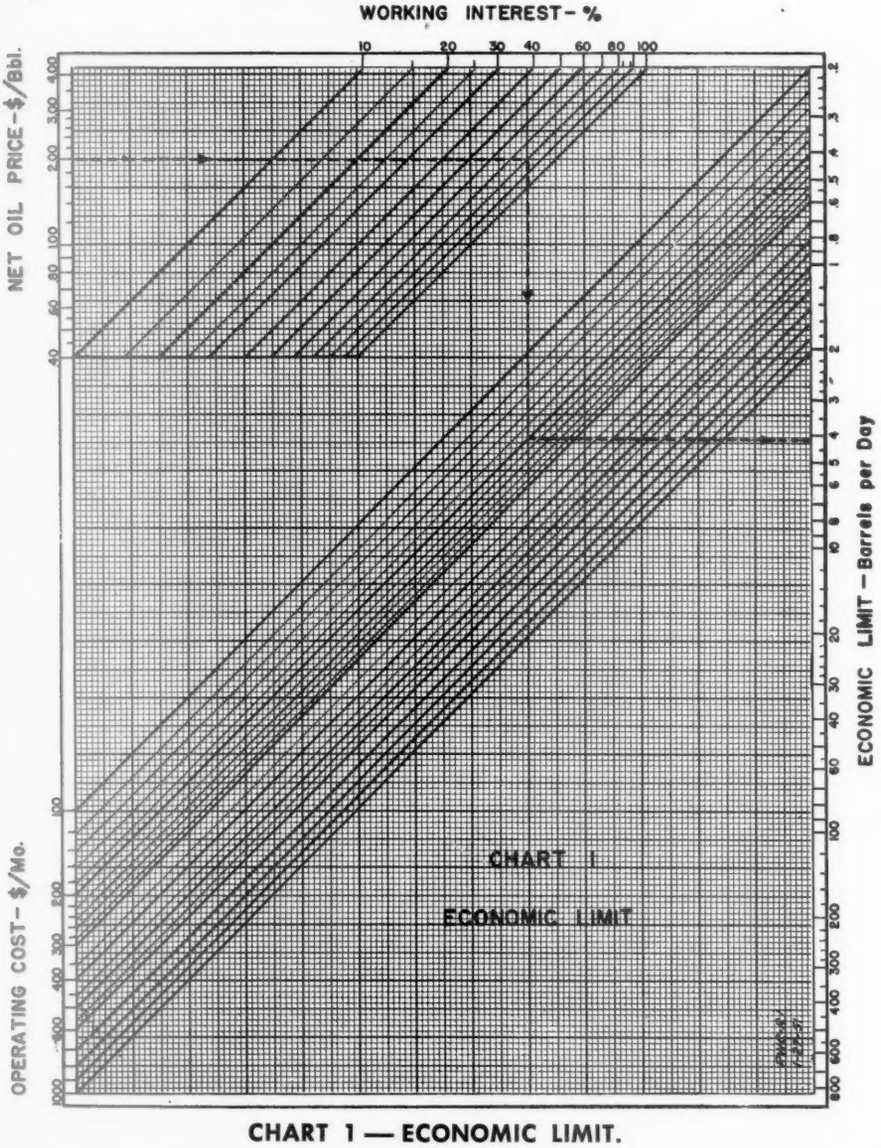


CHART 1 — ECONOMIC LIMIT.

as defined by equation 3.

Thus: in the problem

Current production rate	=	22 B/D
Economic limit	=	4.1 B/D
Calculated rate ratio	=	18.6 per cent
Projected decline rate	=	15 per cent per year
From Chart 2, remaining economic life	=	10.2 Years

C. Estimate remaining economic reserves:

Using the conventional method, the average projected production rate at each midyear is ticked off on Fig. 1, tabulated, and accumulated as follows:

Year	Projected average production rate
1951	20.2
1952	17.2
1953	14.6
1954	12.4
1955	11.4
1956	8.9
1957	7.5
1958	6.4
1959	5.4
1960	4.6
1961 (0.2) × (4.2)	0.8
Total	109.4

Est. reserves = 365 × 109.4 = 40,000 bbl

Chart 3 — "Economic reserves — constant decline" relates:

1. Decline rate in per cent per year,
2. Remaining life in years,
3. Remaining reserves in thousands of barrels per current barrel,

as defined by Equation 5. Note that reserves per current barrel approach a limit as time increases.

Thus: following the problem to conclusion

Decline rate	=	15 per cent per year
Economic life	=	10.2 years
From Chart 3, reserves per current barrel	=	1.83 1000 bbl
And economic reserves	=	40,300 bbl

Chart 3-1—"Economic reserves — constant decline" relates:

1. Production rate ratio,
2. Decline rate in per cent per year,

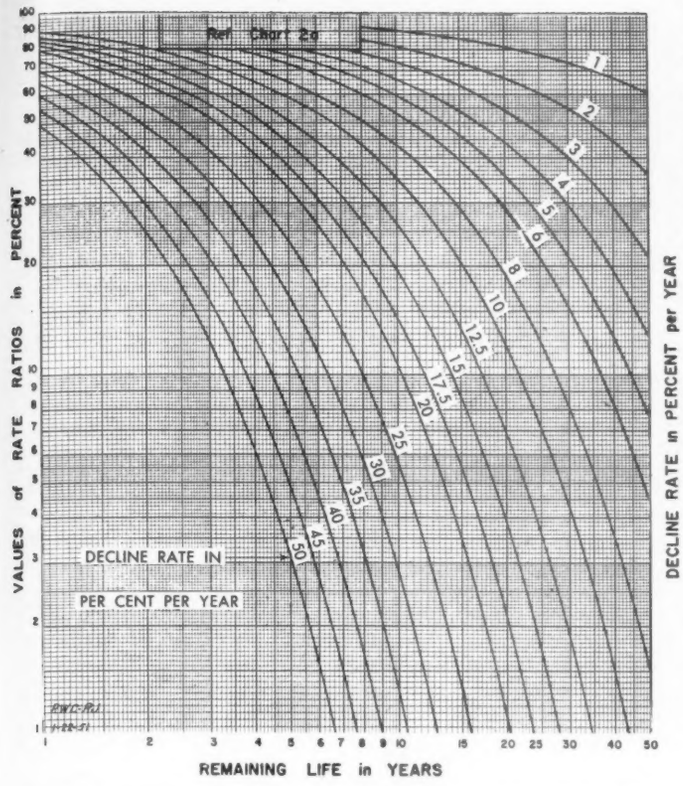


CHART 2—ECONOMIC LIFE—CONSTANT DECLINE.

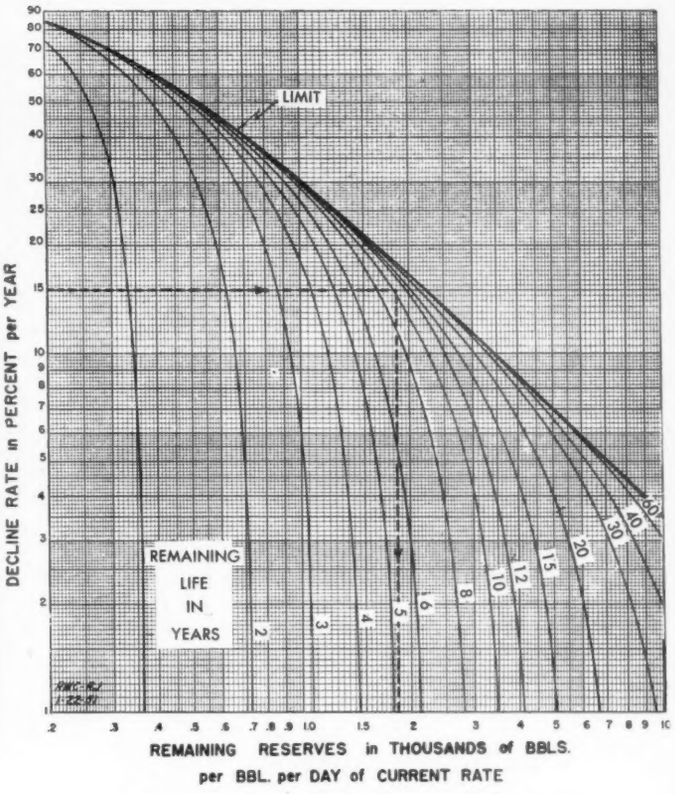

LIMIT
DECLINE RATE in PERCENT per YEAR
REMAINING LIFE IN YEARS
REMAINING RESERVES in THOUSANDS of BBLS.
per BBL. per DAY of CURRENT RATE

CHART 3 — ECONOMIC RESERVES.

3. Remaining reserves in thousands of barrels per current barrel, as defined by Equation 6. Note that reserves per current barrel approach a limit as rate ratio approaches 0.

Thus: in same example

Rate ratio	=	18.6 per cent
Decline rate	=	15 per cent
From Chart 3-1, reserves per current barrel	=	1 83 1000 bbl

PART 2.

Reserve Estimate by Rule of Variable Decline

Fig. 2 illustrates the production history of Well No. 2 plotted versus time on log-log paper using different values on the time scale for current time. Projections to an arbitrary economic limit of 6.5 bbl per day or 20 years are indicated. Again production is accumulated for each curve using the conventional method:

	A	B	C	D
1951	23.0	23.0	23.0	23.5
1952	19.5	20.0	20.1	20.8
1953	17.1	17.8	18.1	18.8
1954	15.2	15.9	16.5	17.2
1955	13.5	14.5	15.0	15.8
1956	12.0	13.3	14.1	14.8
1957	11.0	12.4	13.3	14.0
1958	10.0	11.5	12.6	13.2
1959	9.2	10.7	11.8	12.5
1960	8.5	10.0	11.3	11.9
1961	7.9	9.5	10.8	11.4
1962	7.4	9.0	10.3	11.0
1963	6.8	8.5	9.8	10.5
1964	[3]3.2	8.2	9.5	10.0
1965		7.8	9.1	9.7
1966		7.5	8.8	9.4
1967		7.2	8.6	9.1
1968		6.9	8.3	8.9
1969		6.6	8.0	8.6
1970		[3]3.2	7.8	8.4
Total	164.3	225.5	246.2	259.5
Est. reserves	60,000	81,500	90,000	95,000
Life in years	13½	19½	[4]20	[4]20

[3](½ × 6.5 on account of ½ year.)
[4]Arbitrary.

Chart 4—"Economic reserves—variable decline" relates:

1. Rate ratio or time ratio,
2. Value of current time in years,
3. Slope of projection as ratio,
4. Remaining reserves in thousands of barrels per barrel per day of current production rate.

as defined by equation 10.

Thus, in the above example: Curve B using rate ratio

Current production rate	=	24.7 B/D
Economic limit	=	6.5 B/D
Calculated rate ratio	=	26.3 Per cent
Value of current time	=	61 months
or		5.08 years
Slope	=	—.85
From Chart 4, reserves per current barrel	=	3.26 1000 bbl
And economic reserves	=	80,500 bbl

In a similar manner: Curve C using time ratio

Current production rate	=	24.4 B/D
Value of current time	=	49 months
or		40.8 Years
Value of time at 20 year limit	=	289 months
Time ratio	=	5.90
Slope	=	—.65
From Chart 4, reserves per current barrel	=	3.66 1000 bbl
And economic reserves	=	89,500 bbl

The results of curves A, B, C, and D indicate that for:

1. A better than usual array of points,
2. A typical value of rate ratio,
3. A reasonable selection of values of current time on the time scale,

widely differing estimates of reserves

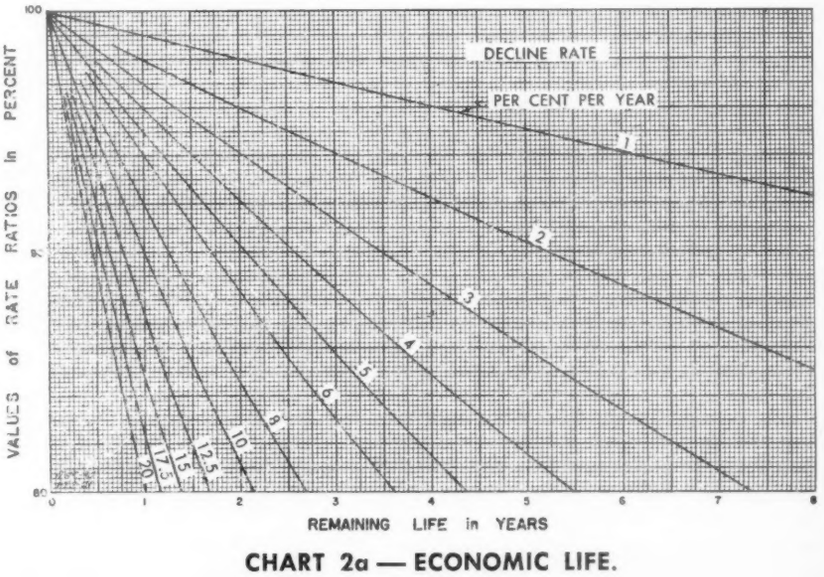


CHART 2a — ECONOMIC LIFE.

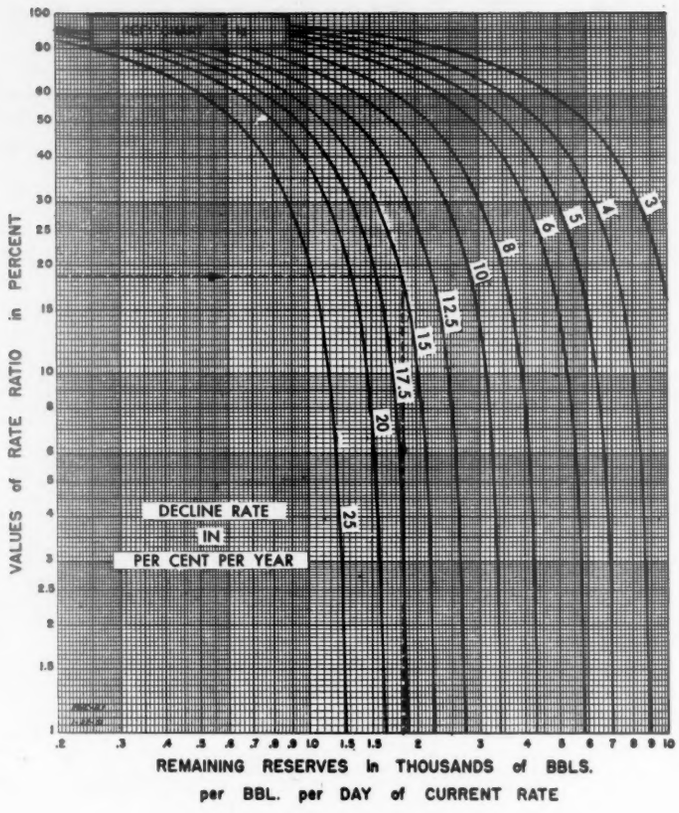

VALUES of RATE RATIO in PERCENT
DECLINE RATE
IN
PER CENT PER YEAR
REMAINING RESERVES in THOUSANDS of BBLS.
per BBL. per DAY of CURRENT RATE

CHART 3-1 — ECONOMIC RESERVES.

can be obtained. The thought is thus confirmed (as any juggler of estimates is well aware) that the method of decline trend is more of an art than a science, and hence requires an experienced operator. In order to assist the estimator to reach a conclusion, pertinent data of the several projections have been tabulated in Table 1.

Fig. 3 is a plot of the data on semi-log paper, which indicates the average decline rates for the three years of history, and a projection of 12 per cent based on the last 6 months production rate. For comparison, an estimate of reserves by constant decline is made from the following data:

Current production rate	=	25.3 B/D
Economic limit	=	6.5 B/D
Rate ratio	=	25.7 Per cent
Decline rate	=	12 Per cent (constant)
Economic life (Chart 2)	=	10.6 Years
Reserves per current barrel (Chart 3)	=	2.1 1000 bbl
Economic reserves	=	53,000 bbl

Evidently the key to a reasonable log-log projection lies in realistic decline rates from the present to the selected limit. From Table 1 it can be seen that of the curves A-D, only curve D has a good value for current decline rate. Probably curve A has the best value for decline rate at the limit, although experience based upon the individual field performance would modify that opinion. In order to give the estimator control over current and final decline rates with respect to the economic life, Chart 5 has been prepared which relates:

1. Current decline rate in per cent per year,
2. Final decline rate in per cent per year,
3. Decline ratio as per cent,
4. Remaining life in years,
5. Value of current time on time scale in years,
6. Time ratio,
7. Slope of projection as ratio,

as defined by equations 11 and 12.

Thus in the above example:

Current decline rate	= 12	per cent per year
Assume final decline rate	= 6	per cent per year
Then decline ratio (6÷12)	= 50	per cent
Assume arbitrary remaining life	= 15	years
From Chart 5:		
Value of current time	= 13.3	years
Value of time ratio	= 2.12	
Value of slope	= —1.8	

This "controlled" projection is plotted in Fig. 4.

Reserve estimate from Fig. 4 by conventional method:

Year	Production rate
1951	23.5
1952	21.0
1953	18.8
1954	16.8
1955	15.1
1956	13.8
1957	12.5
1958	11.4
1959	10.5
1960	9.6
1961	9.0
1962	8.3
1963	7.7
1964	7.2
1965	6.7
Total	191.9
Estimated reserves	70,000

Reserve estimate by Chart 4:	
Current production rate	= 25.3 B/D
Value current time	= 13.3 years
Time ratio	= 2.12
Slope	= —1.8
Reserves per current barrel (Chart 4)	= 2.75 1000 bbl
Economic reserves	= 71,000 bbl

It is admitted that the production history does not follow the projection in Fig. 4, until the most recent months. This is what was intended, however, based on Fig. 3: a realistic current decline rate. The pertinent data are tabulated for comparison in Table 1.

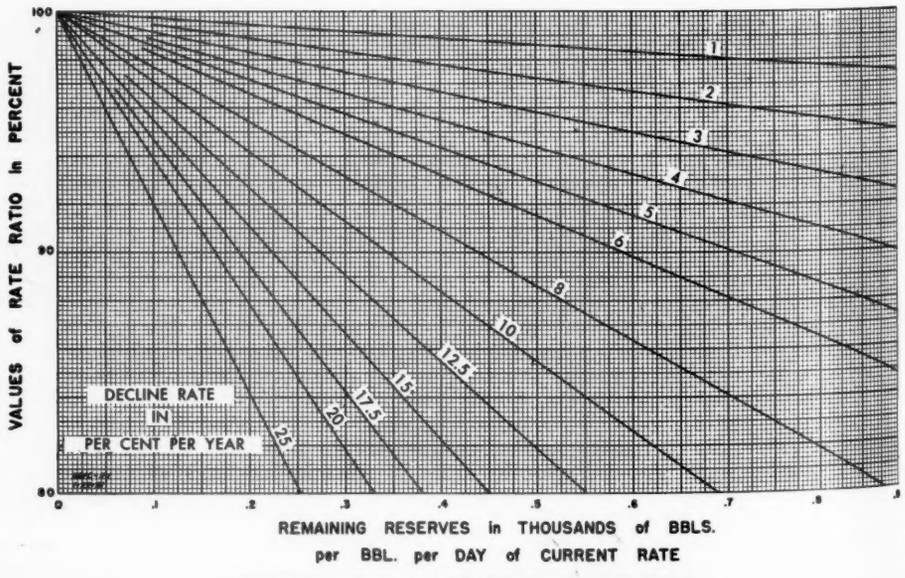

VALUES of RATE RATIO in PERCENT
DECLINE RATE
IN
PER CENT PER YEAR
REMAINING RESERVES in THOUSANDS of BBLS.
per BBL. per DAY of CURRENT RATE

CHART 3-1a — ECONOMIC RESERVES.

TABLE 1. Pertinent data of projections—Well No. 2.

Projection	Current prod. rate 1-1-51	*Rate ratio	*Remaining life	*Remaining reserves	Value current time	Slope	Indicated decline current	Indicated decline final
	B/D	Per cent	Years	1000 bbl	Years		Per cent per year	
A	24.7	26.3	13.4	59.	7.08	—1.26	15.4	6.9
B	24.7	26.3	19.5	82.	5.08	— .85	14.1	3.3
C	25.0	26.0	28.6	114.	4.08	— .65	13.2	2.0
D	24.4	26.6	29.4	119.	4.08	— .62	12.8	1.8
Fig. 3 (constant decline)	25.3	25.7	10.6	53.	....	.....	12.0	12.0
Fig. 4 (variable decline — controlled)	25.3	25.7	15.	70.	13.3	—1.80	12.0	6.0

* To limit of 6.5 B/D.

FIG. 2—WELL 2

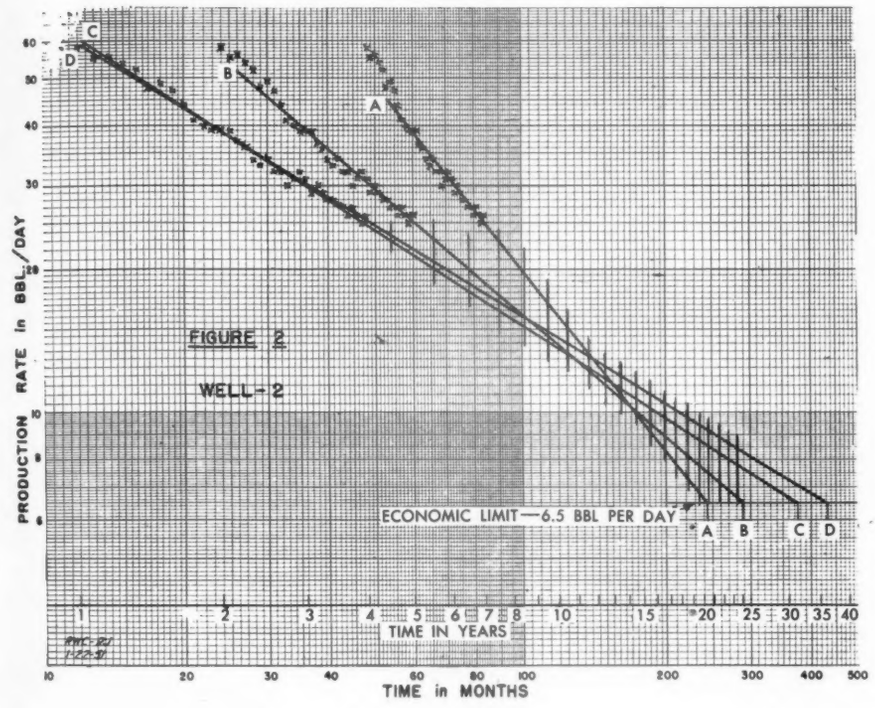
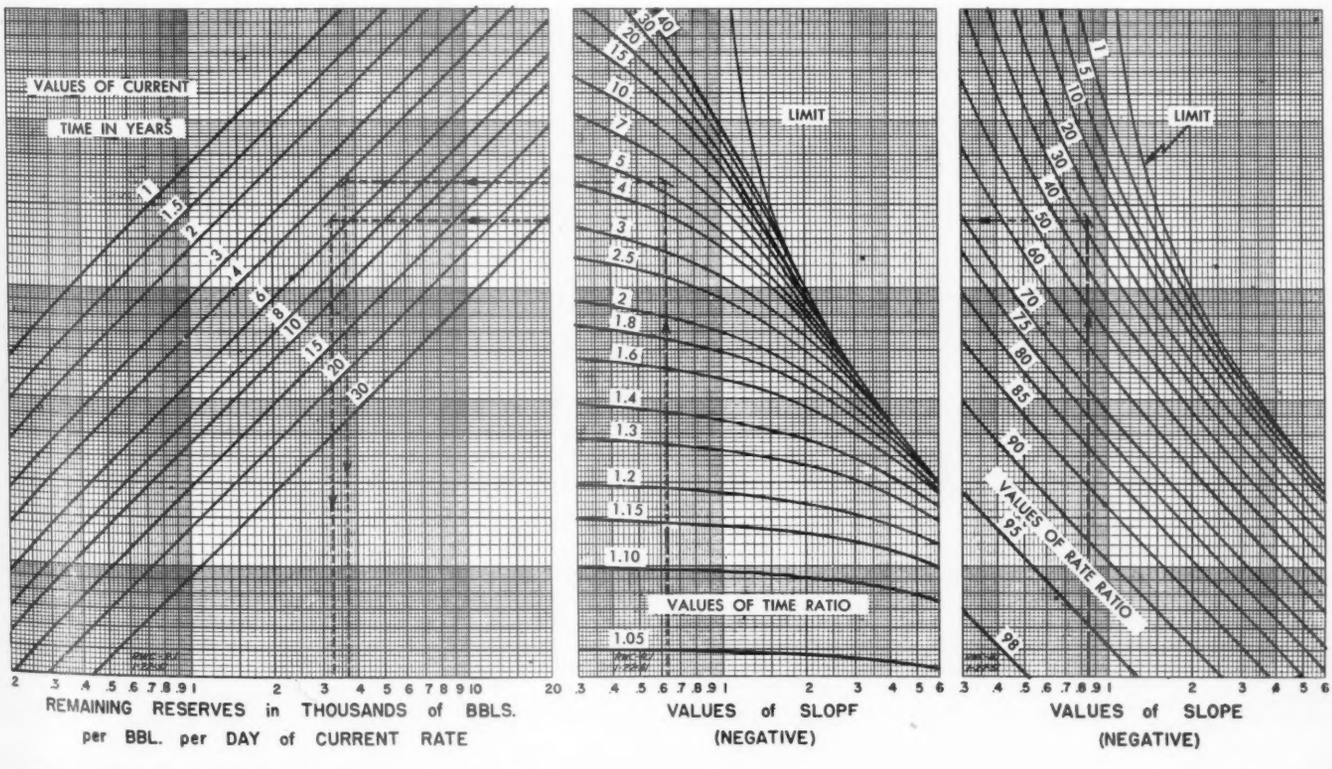


CHART 4



PART 3.

Applications

1. Practical application of rule of constant decline for cases in which a variable decline rate is indicated for remaining life.

For cases in which the decline ratio is 45 per cent or better:

(a) Calculate reserves for approximately first third of remaining life based on current decline rate.

(b) Add the reserves for the balance of the life based on final decline rate.

Thus: In Fig. 5, the production trend from Fig. 4 is plotted on semi-log paper. Using the above approximation:

Current production rate	= 25 B/D
Current decline rate	= 12 per cent per year
⅓ remaining life (arbitrary)	= 5 years
Reserves per current barrel (Chart 3)	= 1.35 1000 bbl
Reserves for first 5 years	= 33.8 1000 bbl
Rate ratio (5 year period, from Chart 2)	= 53 per cent
Final decline rate	= 6 per cent per year
Balance of life	= 10 years
Reserves per current barrel (Chart 3)	= 2.75 1000 bbl
Reserves for last 10 years $2.75 \times (0.53 \times 25)$	= 36.5 1000 bbl
Total reserves	= 70,300 bbl

The reserves computed in this manner compare favorably with the previous estimate based on continuously variable decline. Table 2 shows the effect of small changes of decline rates in this example for purpose of comparison.

For lower values of decline ratio, the following divisions of remaining life may be used to achieve reasonably accurate results:

Decline ratio	First portion remaining life
45 per cent plus	1/3
30 — 45	1/4
20 — 30	1/5

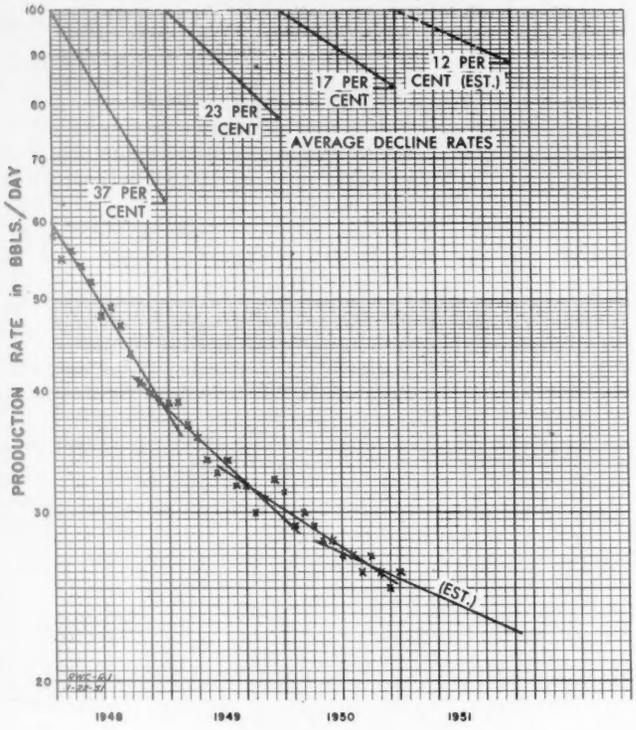


FIG. 3
WELL 2

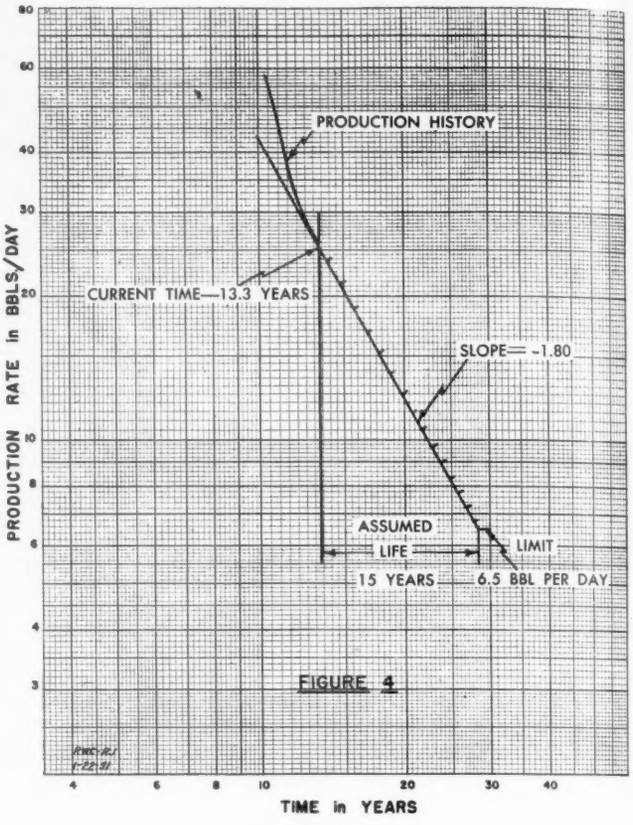
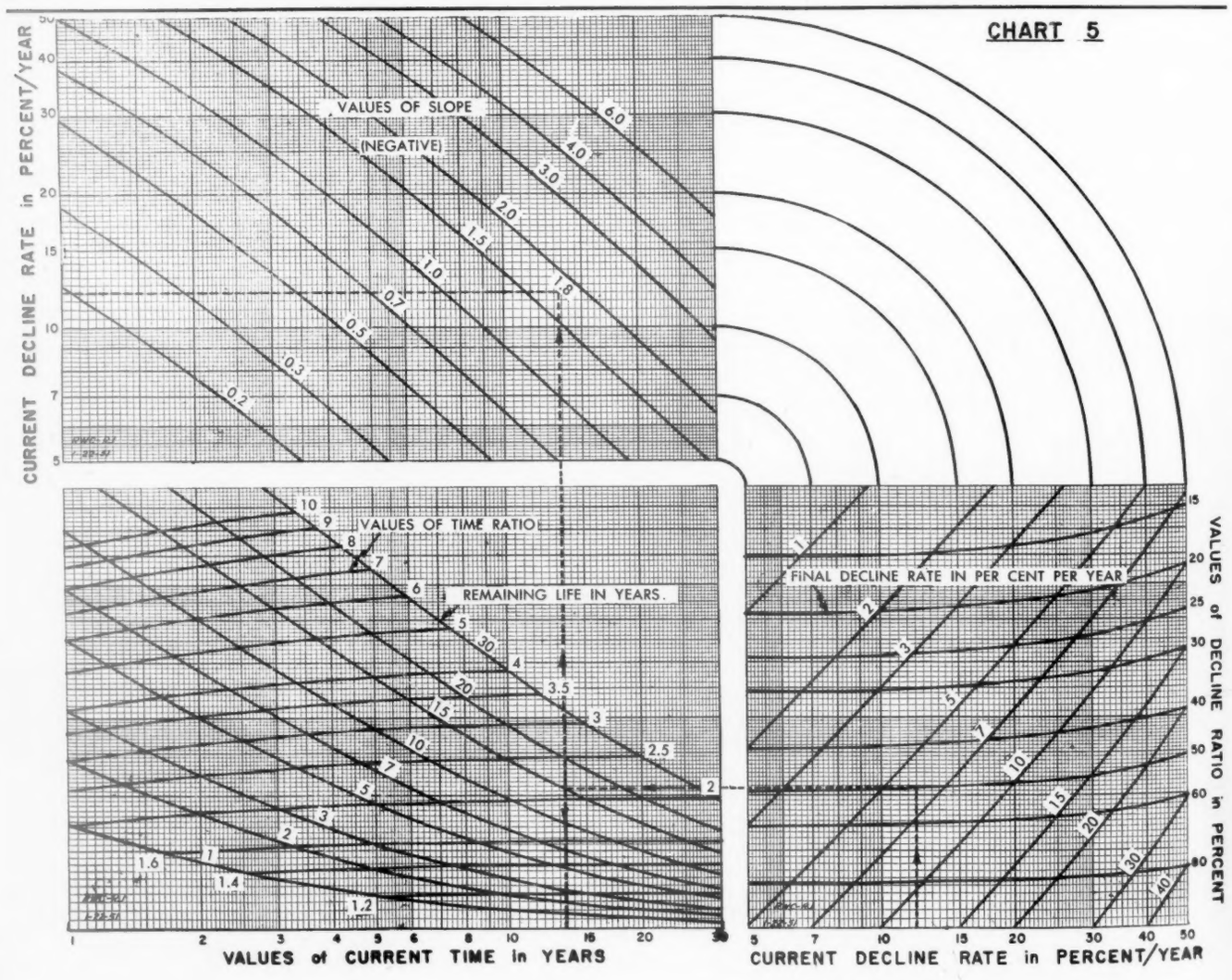


FIGURE 4

FIG. 4

CHART 5


CURRENT DECLINE RATE in PERCENT/YEAR
VALUES OF SLOPE (NEGATIVE)
VALUES OF TIME RATIO
REMAINING LIFE IN YEARS.
FINAL DECLINE RATE IN PER CENT PER YEAR
VALUES of CURRENT TIME in YEARS
CURRENT DECLINE RATE in PERCENT/YEAR
VALUES of DECLINE RATIO in PERCENT

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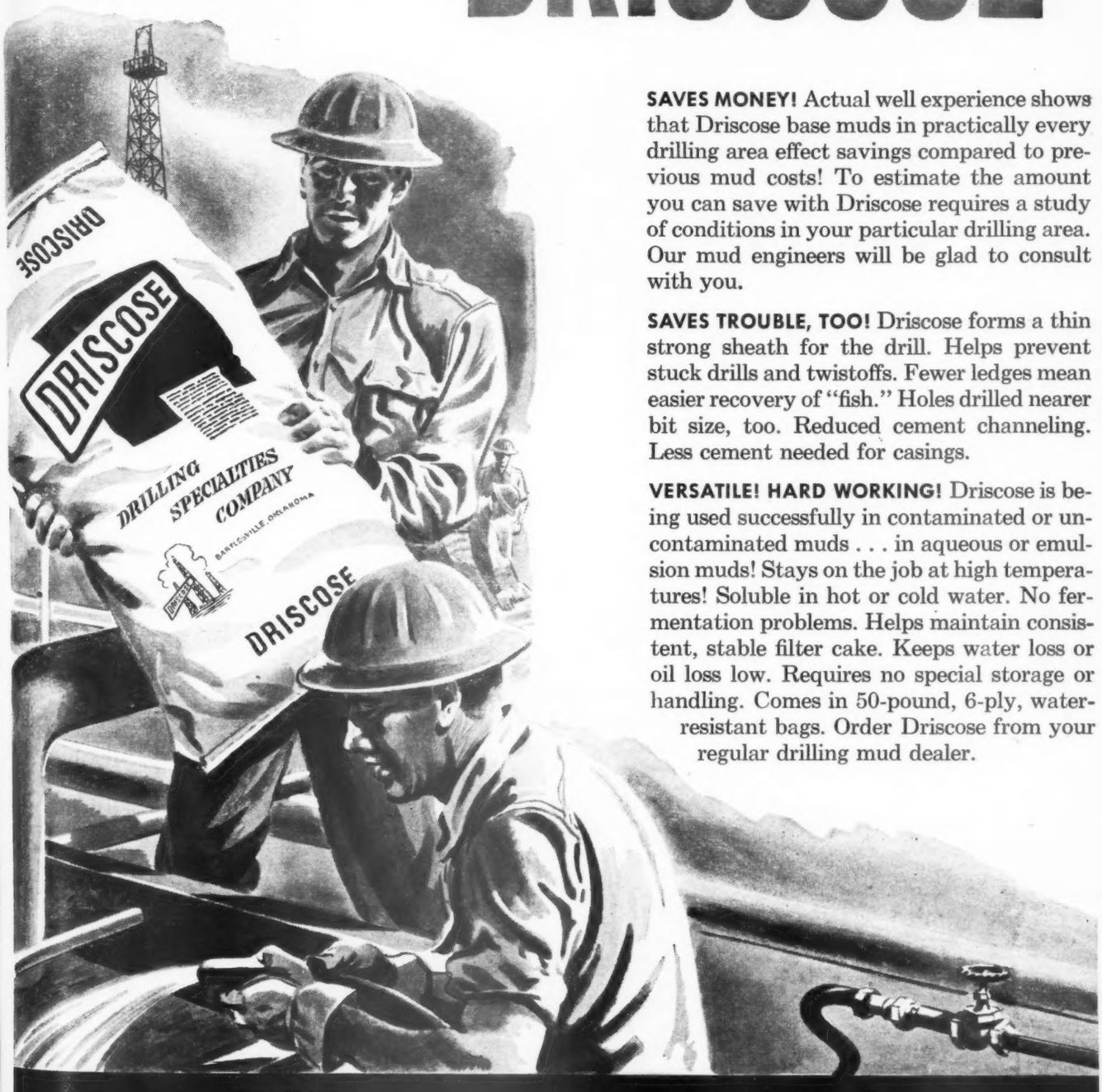

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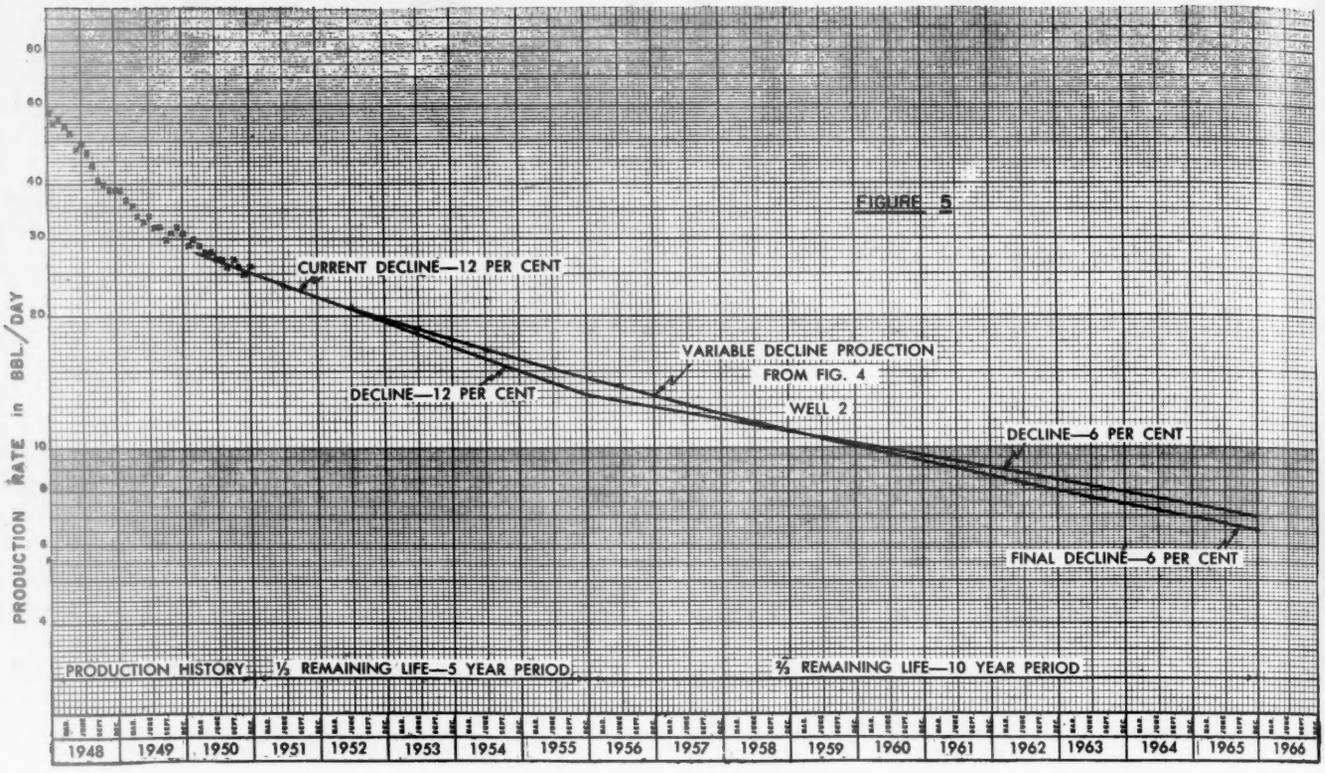


FIG. 5

2. Application of rule of constant decline for cases in which a variable decline rate is indicated for a flush period:

a. Estimate reserves for flush period based on variable decline.

b. Estimate reserves for settled period based on constant decline or as in modification (Case 1) above.

Thus, in Fig. 6:

Current production rate	= 130 B/D
Current decline rate	= 35 per cent per year
Assume flush period	= 5 years
Reserves per current barrel (Chart 3)	= 0.74 1000 bbl
Flush base reserves (130 × 740)	= 96. 1000 bbl
Assume decline rate at end of flush period from field experience	= 12 per cent per year
Calculate decline ratio	= 34.2 per cent
From Chart 7[5] series, find additional reserves (Fig. 6 shaded) due to variable decline	= 19 per cent
Calculate additional flush reserves. (96 × .19)	= 18. 1000 bbl
From Chart 7[5] series, find production rate at end of flush period as per cent of current production rate	= 28 per cent
Calculate production rate beginning of settled period (.28 × 130)	= 36 B/D
Assume economic limit	= 12 B/D
Calculate settled rate ratio (12 ÷ 36)	= 33 per cent
Settled period (from Chart 2)	= 8.6 years
Reserves per current barrel settled period (from Chart 3)	= 1.9 1000 bbl
Reserves for settled period (36 × 1.9)	= 68. 1000 bbl
Summarize:	
Economic life 5 + 8.6	= 13.6 years
Economic reserves 96 + 18 + 68	= 182,000 bbl

[5] Based on formulae 6, 7, 10, 11, 12.

Discount to Present Worth—Constant Decline

Chart 6[6] Series—"Discount Factors" relates:

[6] This series is limited to cases in which operating costs and net oil prices are reasonably constant throughout the remaining economic life, and in which capital expenditures are relatively small.

TABLE 2.

5 year period				10 year period			Total reserves
Current decline rate	Rate ratio	Reserves per bbl	Reserves 1000 bbl	Final decline rate	Reserves per bbl	Reserves 1000 bbl	1000 bbl
13	.49	1.31	32.7	5	2.88	35.3	68.0
12	.53	1.35	33.8	6	2.75	36.5	70.3
11	.56	1.38	34.5	7	2.60	36.5	71.0
10	.59	1.42	35.4	8	2.48	36.6	72.0

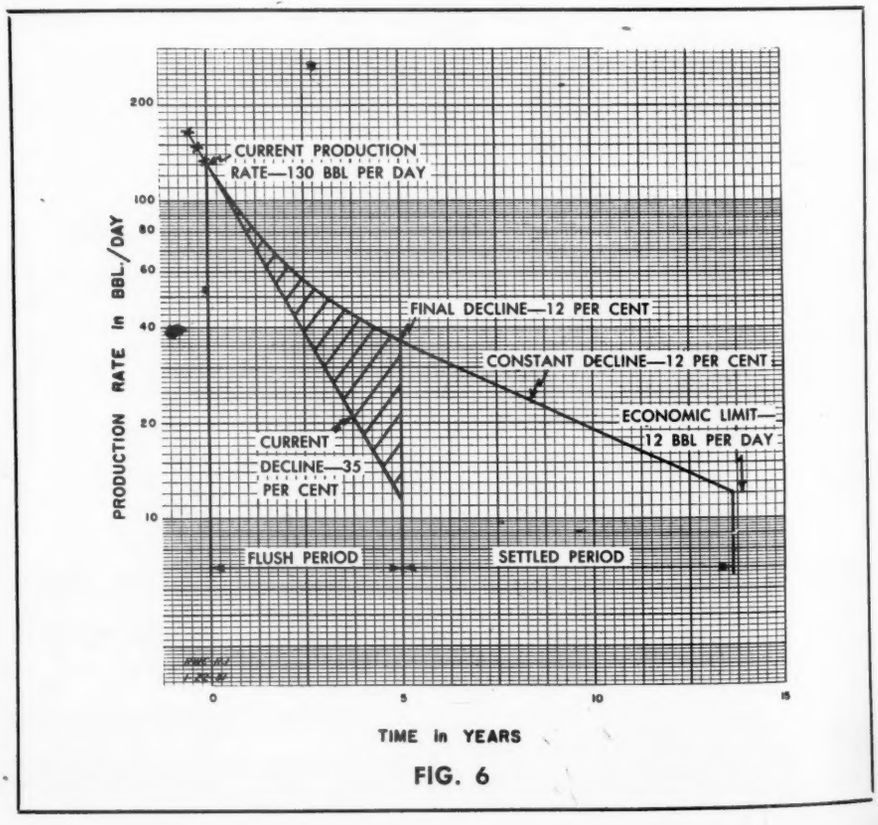
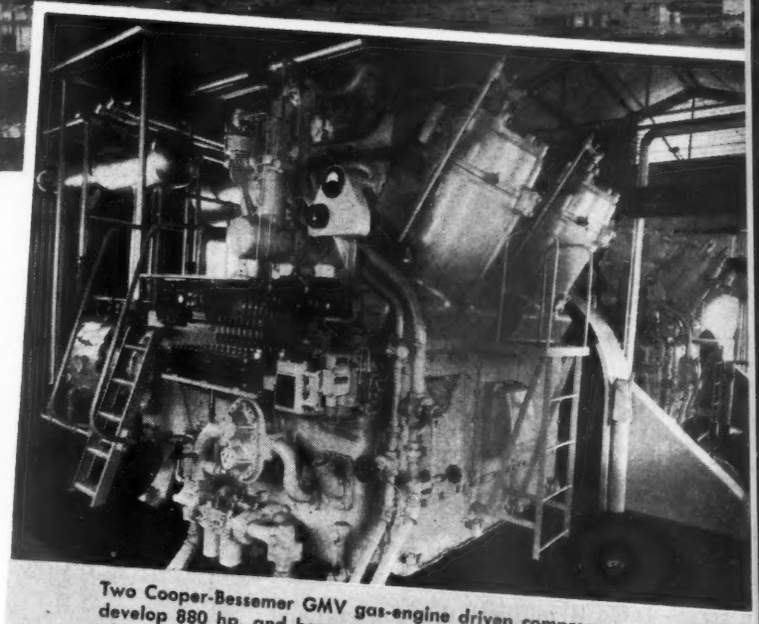


FIG. 6



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In addition to the building, cooling tower, scrubbers and compressor equipment shown, this installation includes a 6-mile gathering line system consisting of pipe sizes from 2" to 8", as well as a residence on the lease for the supervisor.

It was designed and constructed by Deerfield Petroleums, Inc. and is being operated by Universoil, Inc. All equipment and material was supplied by "Oilwell" ... enabling the contractor as well as the operator to centralize procurement details at a single convenient source.

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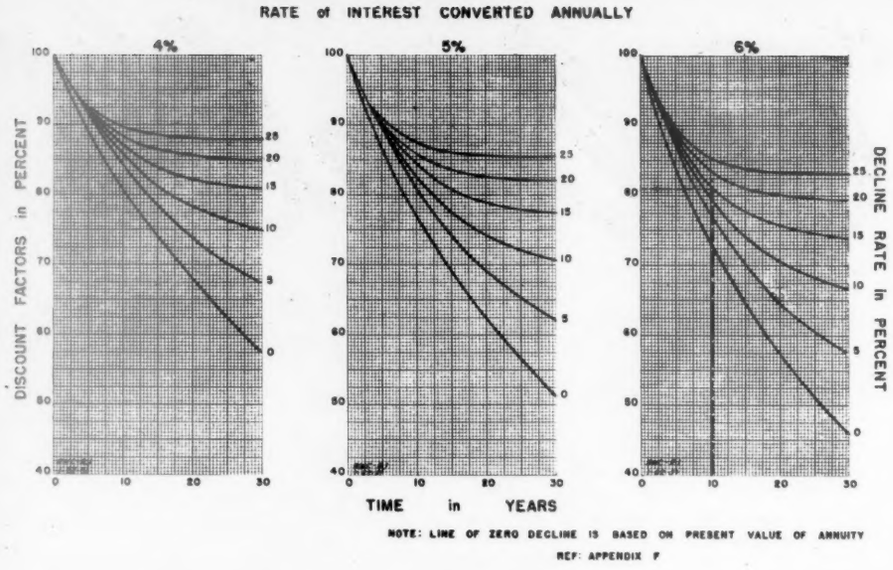


CHART 6

1. Remaining economic life in years.
2. Decline rate in per cent per year.
3. Discount factor in per cent.

Refer to first example in Part 1.

Given:	
Net oil price	$2.00 per bbl
Working interest	80 per cent
Operating costs	$200 per month
Decline rate	15 per cent per year
Interest rate	6 per cent
From Charts:	
Future economic life	10.2 years
Gross future economic reserves	40,300 bbl
Calculate:	
Gross working interest reserves (.8 × 40,300)	32,400 bbl
Working interest—gross income (2.00 × 32,400)	$64,800
Operating costs (10.2 × 12 × 200)	$24,500
Working interest—net income	$40,300
From Chart 6: discount factor	81 per cent
Present worth: net working interest (.81 × 40,300)	$32,600
Present worth: net working interest per barrel future gross economic reserves	$ .81 per bbl

Table 3 outlines the conventional procedure for a similar problem.

APPENDIX A

Symbols		Units
Q	Production rate	B/D
t	Time	years
A	Average production rate at t_1 or "Current Barrel"	B/D
L	Economic or other limit	B/D
T	Time from t_1 to economic or other limit	years
D	Rate of decline at time t	per cent for year
r	Rate of decline at time t	B/D per year
S	Cumulative production from t_1 to t_2	bbl
I	Working interest	per cent
P	"Net" oil price: Oil price plus and minus revenue and expense reduceable to per barrel basis	$/bbl
C	"Net" operating expense applicable on time basis	$/Mo.
i	Interest rate	decimal
R	Discount factor	per cent
U	"Decline ratio": $D_2 \div D_1$	
V	"Time ratio": $t_2 \div t_1$ or $(t_1 + T) \div t_1$	
W	"Rate ratio": $Q_2 \div Q_1$ or $L \div A$	
d	Decline factor: d=1—0.01 D	
d'	"Discounted" decline factor: $d' = \frac{d}{1+i}$	
K	A constant	
n	A constant	

APPENDIX A

Tabular Values of .365(—Ind)

D		D	
1	36.3	20	1.636
1½	24.15		
2	18.07	22	1.469
3	11.98	24	1.330
4	8.94	25	1.269
5	7.12	26	1.212
		28	1.111
6	5.90	30	1.023
7	5.03		
8	4.38	32	.946
9	3.87	34	.878
10	3.46	35	.847
		36	.818
11	3.13	38	.763
12	2.855	40	.714
13	2.621		
14	2.420	42	.670
15	2.246	44	.630
		46	.592
16	2.094	48	.558
17	1.959	50	.527
18	1.839	60	.398
19	1.732		

TABLE 3. Conventional evaluation.

	Estimated production			Working interest				
	Average B/D	Gross bbl	Net W.I. bbl at 80 per cent	Gross income at $2.00	Oper. expense at $200.	Net income	Discount factor	Present worth
1951	20.2	7370	5900	$11,800	$2,400	$9,400	.943	$8,860
1952	17.2	6280	5020	10,040	2,400	7,640	.890	6,800
1953	14.6	5330	4260	8,520	2,400	6,120	.840	5,140
1954	12.4	4530	3620	7,240	2,400	4,840	.792	3,830
1955	11.4	4160	3330	6,660	2,400	4,260	.747	3,180
1956	8.9	3250	2820	5,640	2,400	3,240	.705	2,280
1957	7.5	2740	2190	4,380	2,400	1,980	.665	1,320
1958	6.4	2340	1870	3,740	2,400	1,340	.627	840
1959	5.4	1970	1580	3,160	2,400	760	.592	450
1960	4.6	1680	1340	2,680	2,400	280	.558	160
1961 (0.2)	4.6	340	270	540	480	60	.527	30
		39,990	32,200	$64,400	$24,480	$39,920		$32,890

APPENDIX B

Equation for Economic Limit

1. Basic equation:

$$L = \frac{C}{30.4} \times \frac{100}{PI}$$

Where		Units
L	= Economic or other limit	B/D
P	= "Net" oil price: oil price plus & minus revenue and expense reduceable to per barrel basis	$/B
C	= "Net" operating expense applicable on time basis	$/Mo.
I	= Working interest	per cent

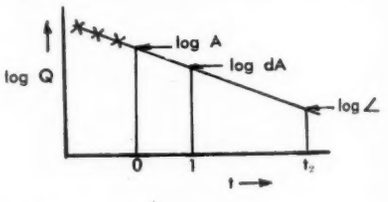
APPENDIX C

Production Rates in B/D of Wells In Illustration

		Well No. 1	Well No. 2
1947	December	36	58
1948	January	37	55
	February	35	56
	March	33	54
	April	34	52
	May	33	48
	June	33	49
	July	34	47
	August	32	44
	September	33	41
	October	29	40
	November	30	39
	December	28	39
1949	January	29	39
	February	31	37
	March	29	36
	April	30	34
	May	28	33
	June	28	34
	July	29	32
	August	27	32
	September	28	30
	October	26	31
	November	25	32
	December	26	31
1950	January	27	29
	February	24	30
	March	26	29
	April	24	28
	May	26	28
	June	24	27
	July	25	27
	August	23	26
	September	23	27
	October	22	26
	November	21	25
	December	22	26

APPENDIX D

Derivations—Constant Decline



Let

Q = Production rate at time t in barrels per day,

A = Production rate when $t_1 = 0$

t = Time in years,

d = Decline factor as defined: $d = 1 - D \times 10^{-2}$ in which,

D = Rate of decline in per cent per year.

Assume constant slope M of straight line above:

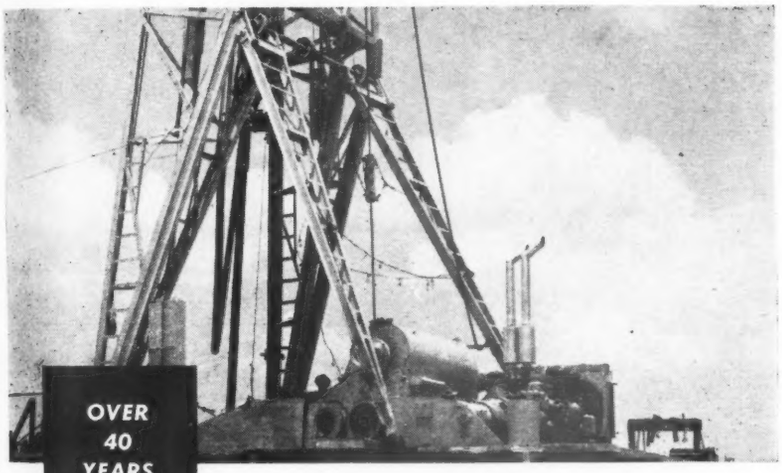
$M = -(\log A - \log dA) \div 1$ or $\log d$.

Equation for straight line:

$\log Q - \log A = \log d\,(t - 0)$ and

My Brewster Rigs have years behind Them...

AND YEARS AHEAD OF THEM



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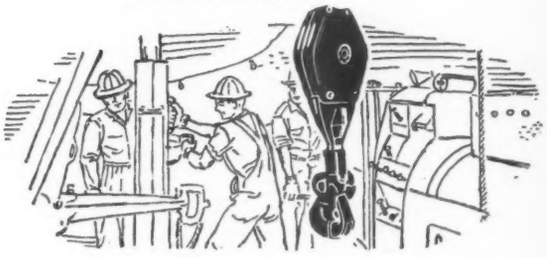
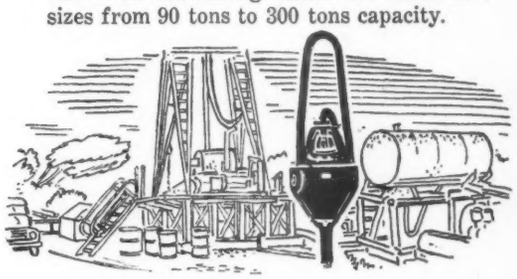


Brewster travelling blocks are made in 5 sizes from 90 tons to 300 tons capacity.



Brewster swivels are made in 5 sizes from 90 tons to 300 tons capacity.

Brewster RSH heavy duty rotaries are made in 18", 22" and 27½" sizes.

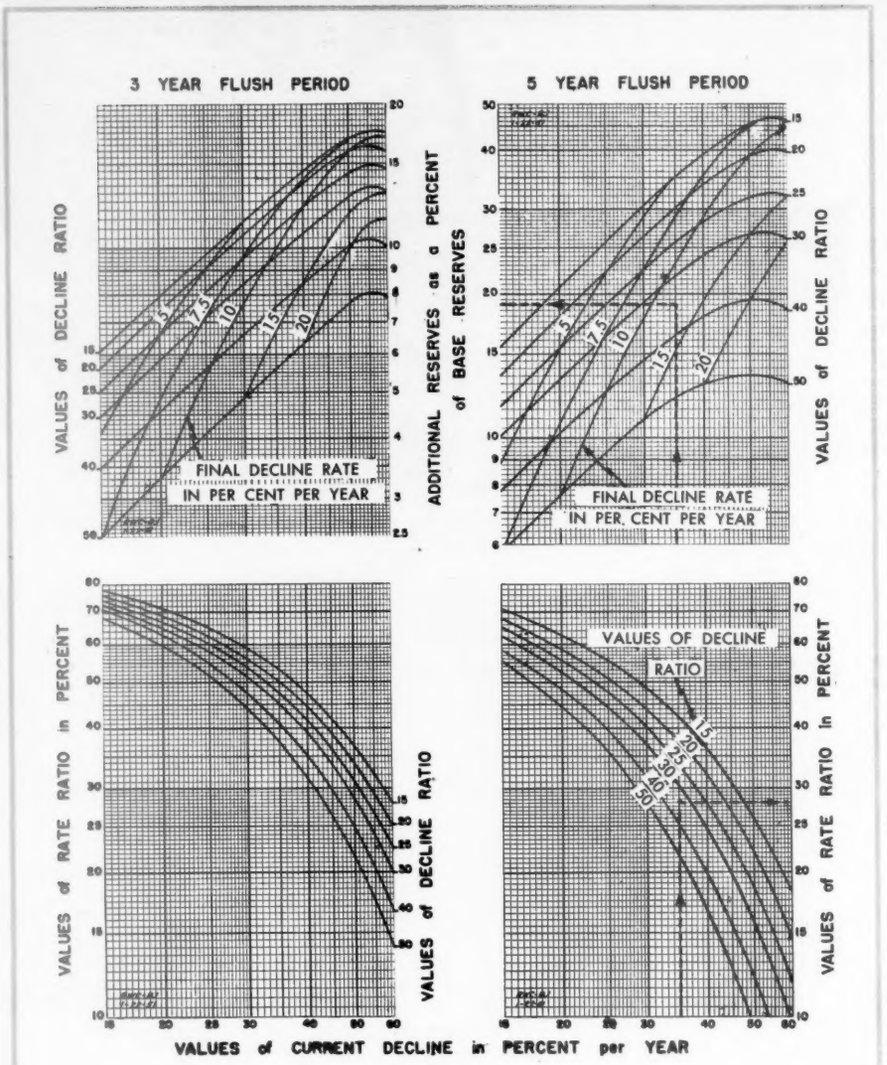

3 YEAR FLUSH PERIOD
5 YEAR FLUSH PERIOD
VALUES of DECLINE RATIO
ADDITIONAL RESERVES as a PERCENT of BASE RESERVES
FINAL DECLINE RATE IN PER CENT PER YEAR
FINAL DECLINE RATE IN PER. CENT PER YEAR
VALUES of RATE RATIO in PERCENT
VALUES OF DECLINE RATIO
VALUES of CURRENT DECLINE in PERCENT per YEAR

CHART 7

APPENDIX A

SUMMARY of FORMULAE

DEPENDENT VARIABLE			CONSTANT DECLINE		VARIABLE DECLINE		
DESCRIPTION	SYMBOL	UNITS	NO.		NO.	$n \neq -1$	$n = -1$
BASIC EQUATION: PRODUCTION RATE at TIME t	Q	B/D	II	Ad^t	VIII	$A\left(\frac{t}{t_1}\right)^n$	$A\frac{t_1}{t}$
RATE of DECLINE at TIME t	D	%/YEAR		D (Const.)	XI	$\left[1-\left(\frac{t+1}{t}\right)^n\right]100$	$\frac{100}{t+1}$
RATE of DECLINE at TIME t	r	B/D/YEAR	IV	$A \cdot \ln d \cdot d^t$	IX	$A \cdot n \cdot \frac{t^{n-1}}{t_1^n}$	$-A\frac{t_1}{t^2}$
TIME from t_1 to LIMIT	T	YEARS	III	$\frac{\log W}{\log d}$	VIII	$t_1(V-1)$ or $t_1(W^{\frac{1}{n}}-1)$	$t_1(V-1)$ or $t_1(\frac{1}{W}-1)$
REMAINING RESERVES per CURRENT BARREL	$\frac{S}{A}$	BBLS.	V VI	$\frac{365}{-\ln d}(1-d^T)$ $\frac{365}{-\ln d}(1-W)$	X	$\frac{365}{n+1}t_1(V^{n+1}-1)$ or $\frac{365}{n+1}t_1(W^{\frac{n+1}{n}}-1)$	$365\,t_1 \ln V$ or $365\,t_1 \ln \frac{1}{W}$
RELATIONSHIP of $t_1, T, D_1, \& D_2$					XII	$\frac{t+1}{t_1} = \left(\frac{t+T+1}{t_1+T}\right)^Z$ where $Z = \frac{\log(1-D_1 \times 10^{-2})}{\log(1-D_2 \times 10^{-2})}$	
DISCOUNT FACTOR	R	PERCENT	XIII	$\frac{\ln d}{\ln d'} \times \frac{(1-d'^T)}{(1-d^T)} \times 100$			

Basic Equation:

2. $Q = Ad^t$

Solution for T: Economic life or time to limit in years:

Let rate ratio $W = L \div A$

$L = Ad^T$ and

$$3.\ T = \frac{\log W}{\log d}$$

Solution for r: Decline rate in barrels per day per year.

$$4.\ r = \frac{dQ}{dt} = A \cdot \ln d \cdot d^t$$

Solution for S: Economic or remaining reserves in barrels:

$$S = \int_{t_1}^{t_2} Q\,dt$$

$$5.\ \frac{S}{A} = \frac{365}{-\ln d}(1 - d^T)$$

As T increases:

$\frac{S}{A}$ approaches $\frac{365}{-\ln d}$ as a limit.

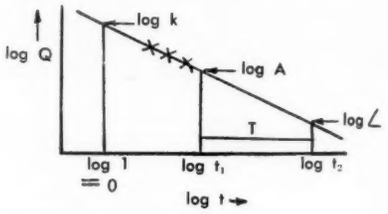
$$6.\ \frac{S}{A} = \frac{365}{-\ln d}(1 - W)$$

When $W = 0$:

$$\frac{S}{A} = \frac{365}{-\ln d}$$

APPENDIX E

Derivations—Variable Decline



Let

Q = Production rate at time t in barrels per day,

K = Production rate when $t = 1$

A = Production rate at time t_1.

Assume constant slope n of straight line above, then

$$n = \frac{d \log Q}{d \log t} = \frac{dY}{dX}$$

integrating

$$\log Q = n \log t + C$$

when $\log t = 0$, $C = \log K$

$$\log Q = n \log t + \log K \quad \text{and}$$

Basic equation:

$$7.\ Q = Kt^n \text{ or } Q = A\left(\frac{t}{t_1}\right)^n$$

Solution for T: Economic life or time to limit in years in terms of rate ratio W:

(Continued on Page B-35)

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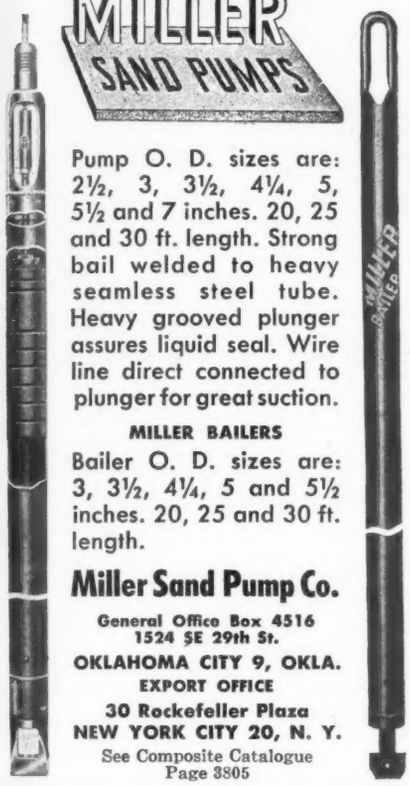

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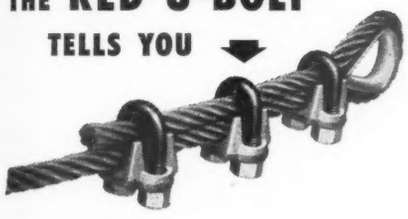

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(Continued from Page B-18)

$$L = K t_2^{\,n}$$

$$A = K t_1^{\,n}$$

$$\text{and } W = \left(\frac{t_2}{t_1}\right)^n = V^n$$

where V = "time ratio"

$$T = t_2 - t_1 = t_1 (V - 1)$$

$$T = t_1 (W^{\frac{1}{n}} - 1)$$

Solution for r: Decline rate in barrels per day per year.

$$9.\ r = \frac{dQ}{dt} = An \cdot \frac{t^{n-1}}{t_1^{\,n}}$$

Solution for S: Economic or remaining reserves in barrels.

$$S = \int_{t_1}^{t_2} Q dt$$

For cases except when $n = -1$

$$\frac{S}{A} = \frac{365}{n+1}\left(\frac{t_2^{\,n+1}}{t_1^{\,n}} - t_1\right)$$

$$Xa \cdot \frac{S}{A} = \frac{365}{n+1} t_1 (V^{n+1} - 1)$$

$$Xc \cdot \frac{S}{A} = \frac{365}{n+1} t_1 (W^{\frac{n+1}{n}} - 1)$$

When $n = -1$

$$\frac{S}{A} = 365\ t_1\ (\ln t_2 - \ln t_1)$$

$$Xb \cdot \frac{S}{A} = 365\ t_1 \ln V$$

$$Xd \cdot \frac{S}{A} = 365\ t_1 \ln \frac{1}{W}$$

Note:
When $n < -1$
as V increases or
as W decreases

$\frac{S}{A}$ approaches $-\frac{365\ t_1}{(n+1)}$ as a limit

Solution for relationship between:

Current decline rate	D_1
Final decline rate	D_2
Decline ratio	U
Time to limit	T
Slope of projection	n
Value of current time	t_1

Let
d = decline factor as defined in appendix D
$d = 1 - D \times 10^{-2}$ in which
D = Rate of decline in per cent per year.

$$11.\ d = \frac{Q(t+1)}{Q_t} = \left(\frac{t+1}{t}\right)^n$$

$$n = \log d_1 \div \log\left(\frac{t_1+1}{t_1}\right)$$

$$n = \log d_2 \div \log\left(\frac{t_1+T+1}{t_1+T}\right)$$

$$\frac{\log d_1}{\log d_2} = Z = \frac{\log (t_1+1) - \log t_1}{\log (t_1+T+1) - \log (t_1+T)}$$

$$12.\ \frac{t_1+1}{t_1} = \left(\frac{t_1+T+1}{t_1+T}\right)^Z$$

APPENDIX F

Derivations—Discount to Present Worth

Equation V:

$$\frac{S}{A} = \frac{365}{\ln d} \cdot (1 - d^T)$$

is a form that can be used conveniently to reduce future income to present worth. This is not a banker's method: In effect each increment of declining production is reduced to present worth, on the basis of interest converted annually.

Basic equation: $Q = Ad^t$

Present value: (discounted barrels) $Q' = A\left(\frac{d}{1+i}\right)^t$

where i = rate of interest as a decimal, and

$$Q' = Ad'^t$$

Equation V converts to

$$\frac{S'}{A} = \frac{365}{\ln d'} \cdot (1 - d'^T)$$

Let R = discount factor

$$R = \frac{\frac{S'}{A}}{\frac{S}{A}} = \frac{\ln d}{\ln d'} \cdot \left(\frac{1 - d'^T}{1 - d^T}\right)$$

Note: On Chart 8, lines have been inserted for "Zero decline." For comparison, these are based upon the standard formula for present value of an annuity:

$$\frac{1 - (1+i)^{-t}}{i}$$

It will be noted that the discount values in this case are slightly less than those of the formula for R. This difference arises because the formula for R assumes the present value of the sum of every increment of production (or income) as it is produced, as opposed to the present value of production accruing to and being paid for at the end of each year.

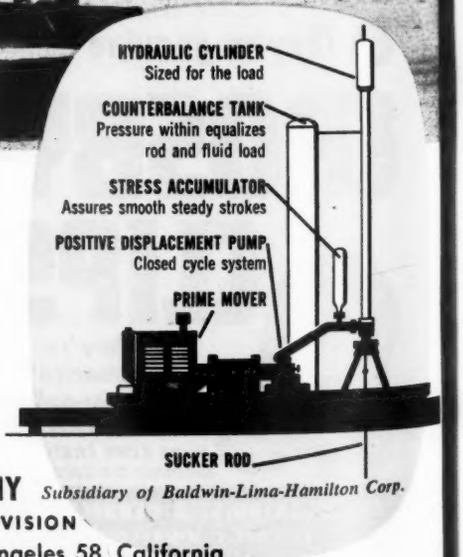
Acknowledgment

Acknowledgment is given R. J. Fernandes and R. E. Martin for constructive suggestions and criticism; and also to Richfield Oil Corporation for their permission to publish this paper.

* * *

PELTON

Long Stroke Hydraulic Pumping Jack



Here in a West Texas field is a typical installation of a PELTON Long Stroke Hydraulic Pumping Jack. This is the most modern, most efficient surface pumping unit ever devised for the sucker rod pumping of oil wells. With PELTON, each well may be pumped to its maximum potential and lifting costs reduced to the absolute minimum.

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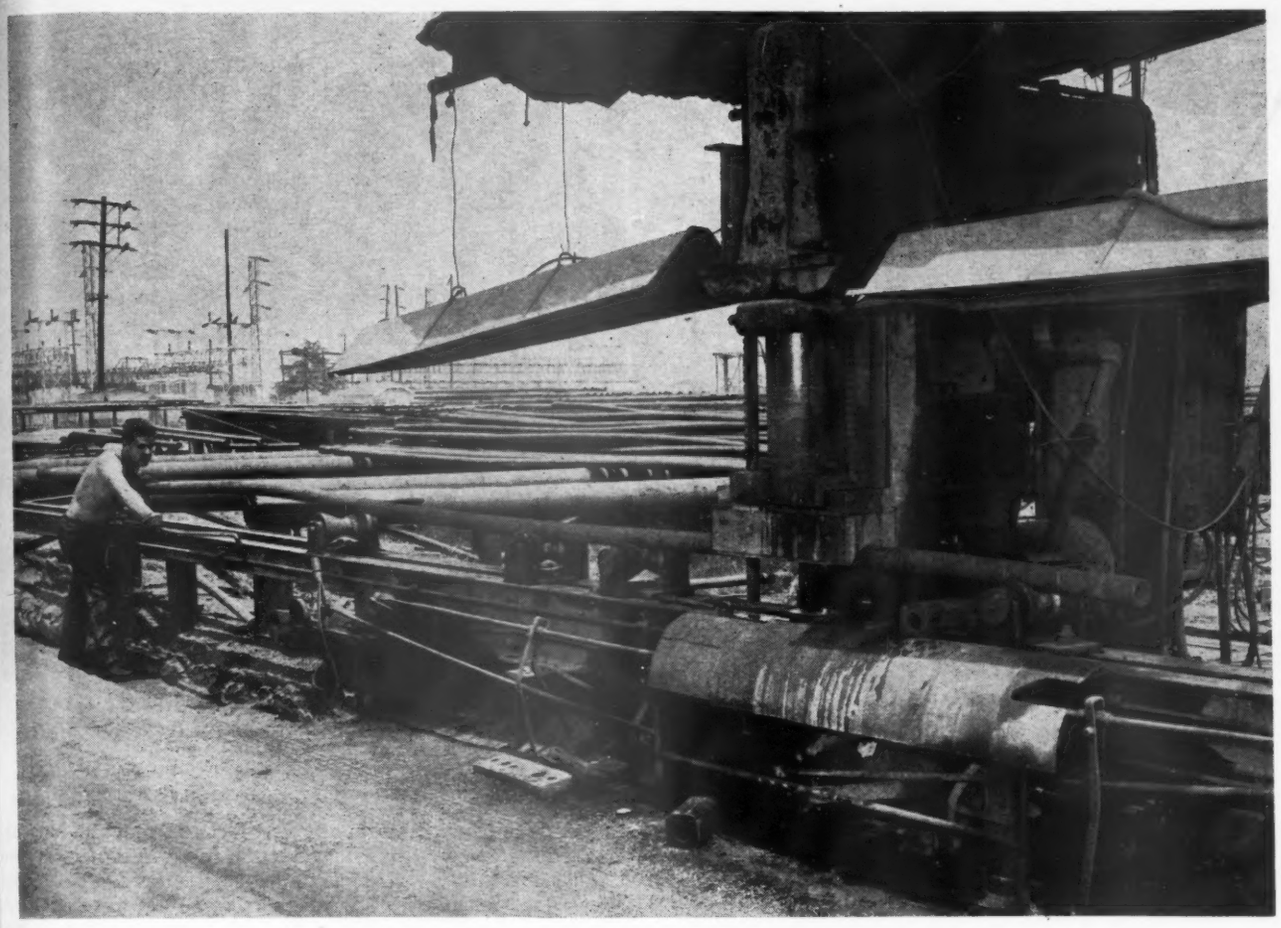


This is the straightening machine. Note the joint of corkscrewed tubing under the ram and other joints awaiting their turn to be dekinked.

How to Recondition Pipe

An important conservation measure is the restoring to use of oil country tubular goods that have been damaged

RICHARD SNEDDON†

In these days of steel scarcity and close allocation, conservation of oil country tubular goods in every possible manner becomes a prime necessity. The salvaging of casing, tubing, drill pipe, and line pipe whenever and wherever it can be done is as necessary to the success of the overall exploration and production program as is oil itself to the national security. There has never been a time, indeed, in the history of the oil business when the search for additional reserves was so assiduously carried on and so urgently required.

Anyone with even a cursory knowledge of drilling and production processes must be cognizant of the fact that without adequate supplies of tubular goods, the whole future of the system is seriously impaired. By the same token, also, although there are alternate methods of petroleum transfer, the lack of additional line pipe would slow down movement rates, add to costs, and in general endanger the efficacy of the entire transportation effort. The importance, thus, of any and all pipe recovery and reconditioning to the industry in the present period of world unrest is inescapable.

EXCLUSIVE

We have recently examined the processes of a pipe reconditioning organization, situated in Santa Fe Springs, California,* which seems to be carrying on a well designed plan of pipe repair and salvage that, to judge by the volume of business going through the plant, is much appreciated by western operators. The routine in this instance begins with the hauling of the pipe from the point of usage to the plant, an operation that may either be performed by the customer himself, or be taken care of by the plant at a flat tonnage-mile rate. Tubing or casing may be subjected to a Dialoy

†Pacific Coast editor.

*Hearn Company.

Joint of casing is drifted with a standard API drift. This determines whether the pipe is still true, within allowable tolerances, to prescribed internal dimensions.

W. S. Looper, inspector, gages wall thickness with a micrometer in his search for deviations from API standards.

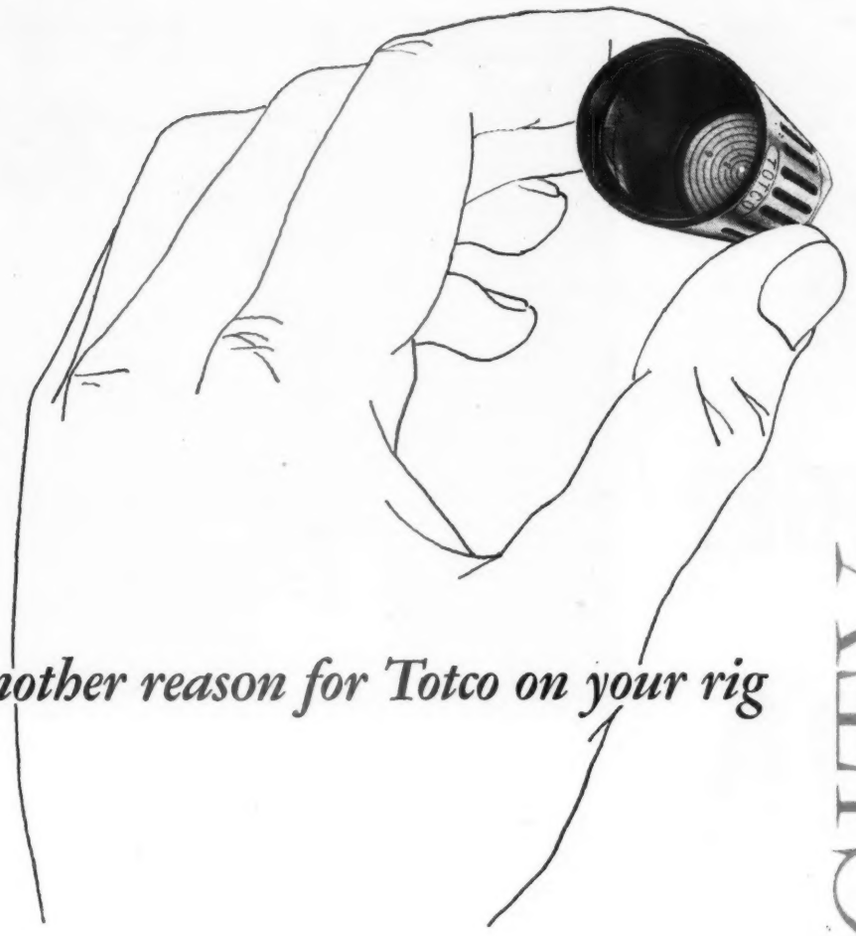
test in the hole before pulling, to determine variations in wall thickness occasioned by corrosion, abrasion, or other influence, but if not so tested in the field may be later tested at the plant.

Upon its arrival at the plant, the pipe is unloaded, racked, and is then subjected to a most meticulous inspection. Damaged joints are first segregated and marked for subsequent treatment. Then all twisted, bent, or warped joints are restored to their original shape with an hydraulic ram. The straightening machine is capable of delivering a 90-ton water squeeze although that much is rarely necessary to accomplish the desired end. A considerable porportion of the tubing received has to be straightened in this manner and it is not unusual, when a string has corkscrewed in the hole, to have to straighten every joint. It is, of course, impossible to perform other essential gaging and measuring tests on the pipe until it has been unkinked, hence the straightening operation is one of the first to be applied.

When the straightening process has been completed, casing or tubing is next checked with an API drift to determine whether or not it conforms, within the prescribed tolerances to the required internal dimensions. After that, if it has not already been Dialoyed in the field, it is subjected to that test. Meantime, threads in couplings are cleaned and gaged to API specifications. The cleaning is done with a mechanical wire brush and this treatment is followed with a solvent wash. Threads are gaged with a dial indicator micrometer for lead, depth, and taper, and any that have been mashed or injured in any way are recut to API standards. Female threads are only recut when all the conditions make it advisable to do so, and couplings that can not be restored economically are discarded.

Next the pipe is pressure tested hydraulically to the original mill pressure in order to locate leaks, if any. This is accomplished by means of a device designed and built at the plant. It consists of two heads, one stationary and one movable together with the pumping

This is the hydrostatic tester used to locate leaks, if any, with a joint of casing undergoing test. Water is first injected with a centrifugal pump and then raised to 1500 psi with a triplex unit.



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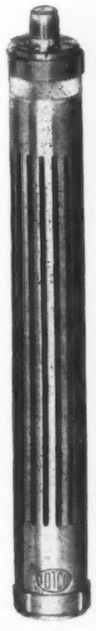

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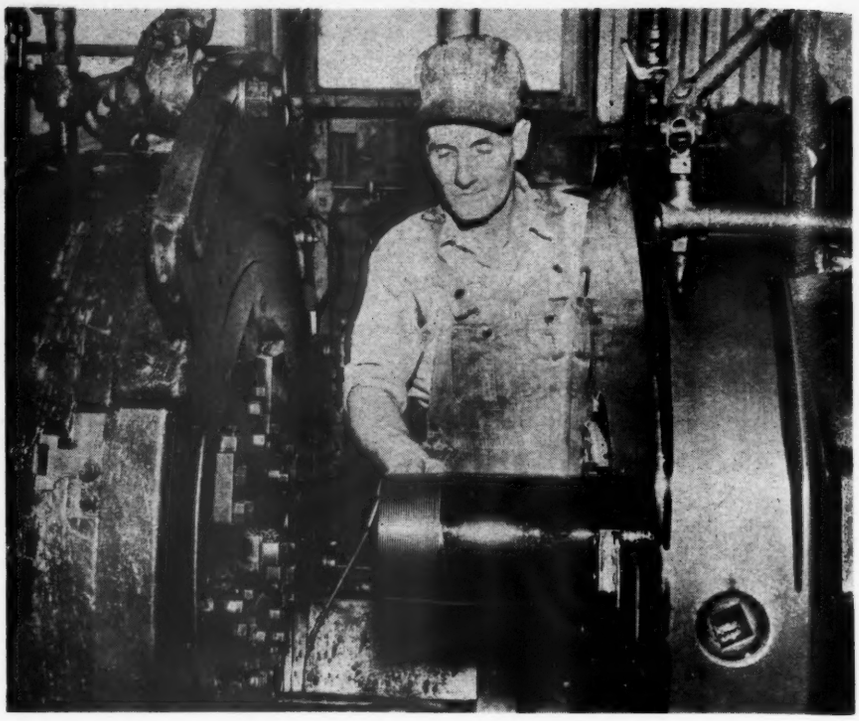


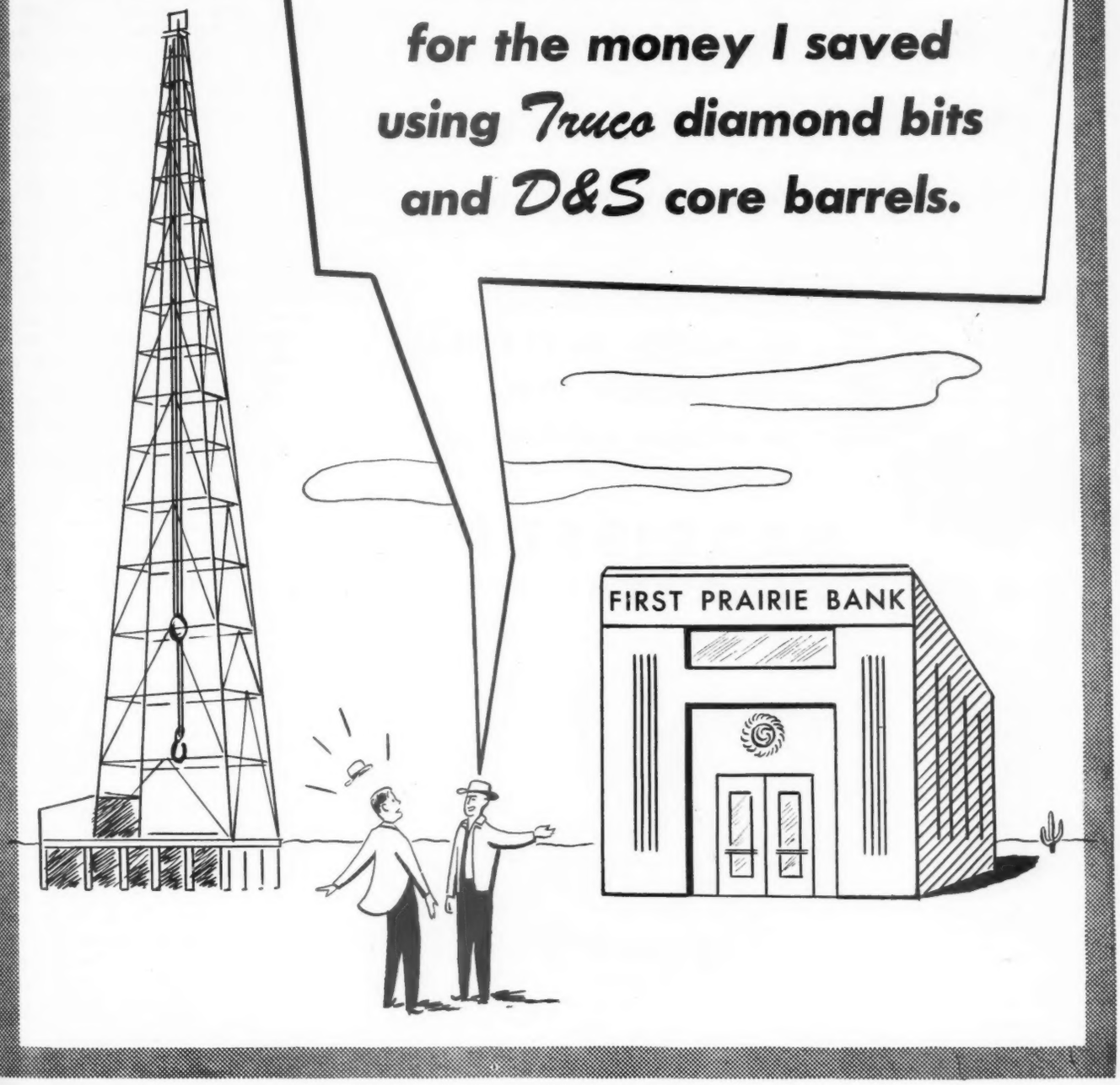
Receding diehead pipe threading machine, with C. W. Kelly checking over his work.

equipment to inject the water. The pipe to be tested is fitted between the two heads with final adjustment being made at the movable end. Pressure tight joints are contrived through the use of rubber gaskets that expand when the pressure is applied, thus sealing off the ends. Cold water is pumped into the pipe through the stationary head, first with a centrifugal pump and the pressure is then built up to the required limit with a triplex horsepower pump unit. Maximum pressure that can be built up in this device is 6000 psi, which is adequate to reveal any weakness. Failure is indicated by a pressure drop or by actual water leakage.

When the pipe has been pressure tested in the above manner, threads are coated with a protective lubricant and if no caps are available to shield the male ends, they are given a heavy wrap of asphalt paper, held firmly in place by a metal strap. Any injured joint that can not be returned to service in its entirety but is capable of being partly salvaged at a reasonable cost, is given special treatment. In casing, for example, that shows local defects, the bad section may be simply cut out. Other joints of casing and tubing that are too badly affected to continue in their regular service are, with the permission of the customer, adapted to uses in which they will be required to withstand lesser stresses and strains. Such joints, for instance, may be scarfed for welded line pipe or threaded for

Operator at left is miking the taper on a joint of newly threaded casing; one at right is applying metal strap to a protective wrapping of asphalt paper.

Had to have a place for the money I saved using Truco diamond bits and D&S core barrels.



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coupled line pipe. Those that fail to come up to API standards in any one of the classifications are simply junked.

Drill pipe after being brought into the yard is straightened if necessary and is examined carefully for tong or slip marks that may be of sufficient severity to affect the strength or general utility of the joint. If any joint appears to be badly worn or damaged it is rejected. Threads are then cleaned and gaged for lead, depth, taper, and are gaged for thread standoff. Threads are recut when this is warranted and it can be done without carrying them outside of API specifications. All threads are then given a coating of dope to protect them until the joints go into service again. With reasonable care being exercised no wrapping is necessary on drill pipe male threads because there is enough shoulder to guard against damage.

Line pipe as a rule when unearthed is caked with dirt, rust, old protective coating scale and all manner of accretions and adhesions, and may even be quite badly bent. Inside, also, may be found sizable quantities of scale and sludge, and there are frequently pitholes here and there, depending both on the type of soil in which the pipe has been embedded and the types of commodities that the lines has been carrying. In any case, when a line is taken up, it is customary to cut it into 40-ft lengths for convenient handling. When it has been taken to the plant, those joints that need to be straightened are sent to the straightening machine. After that the pipe is scraped and buffed inside and out, by pipe cleaning machines and any pitholes that can be filled up economically by the welder are taken care of. The final treatment is a uniformly applied coating of bituminous primer or other coating that assures the arrival of the pipe back in the field in good shape.

Provision is made where requested for the storage of reconditioned pipe, that is, when it is not immediately required by the customer, and when the latter is not interested in the return of rejected pipe, the plant disposes of it in the customer's behalf. In this plant, facilities are available for testing and reconditioning up to 16 in. casing and to a maximum per-joint length of 50 ft. The receding die-head type pipe threading machine that is used can take OD sizes up to 13⅜-in. and is equipped with hydraulic lifts so that no back-breaking labor is involved. Overhead cranes and other yard facilities enable all operations to be processed both efficiently and expeditiously.

Besides having all the essential machinery for the reconditioning and salvaging of the most commonly used types of oil country tubular goods, the plant is well provided with rack and storage room in which it will hold any pipe consignment until the customer is ready to receive it. Every effort is put forth to save as much of the pipe as is possible. In fact, regardless of their nature, all ordinary imperfections are either corrected or the sections in which they are contained are removed and the pipe is then either returned to usable status, for its regular purpose, is adapted to a new use, or, when neither of these contingencies can be met, is purchased as scrap metal. The customer, as already noted may deliver his own pipe to the plant or may have it picked up and delivered by the reconditioning plant's transportation department.

Most operators are at the moment keenly conscious of the need for stringent pipe conservation measures and these reconditioning facilities seem to be very much in demand. According to Sabin Gray, general foreman, it has been going at full capacity for some time and with the impending step-up in exploratory drilling there is not likely to be any slack-off in the immediate future. In any case, this represents a very tangible contribution to the pipe shortage problem. It may not be altogether altruistic but is unquestionably effective.

Every foot of used casing, tubing, drill pipe, or line pipe that can be saved and extended in service is another foot that can be devoted to new drilling, new production, or new transportation. Pipe, of course, is not the only essential to future progress but it is certainly one of major consequence. Indeed, now that the searchers are probing deeper and deeper into the earth in their quest for additional petroleum reserves, pipe conservation is not a matter of choice, it is a patriotic obligation. * * *

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Investigation of

Torque Converter Drives on Mud Pumps†

DAVID F. TOOMEY* and ERNEST G. CHILTON**

Abstract

The construction, application, and fluid flow characteristics of power slush pumps were analyzed as compared to direct-acting steam-driven slush pumps. This comparison was designed to show that direct-acting steam operation provides virtually a non-pulsating discharge as compared with the strongly pulsating discharge and pressures of a power pump. The pressure pulsations of a power pump are a function of the rate of change of fluid flow, which in turn is proportional to pump speed. Therefore, it is indicated that a reduction of pressure pulsations can be accomplished by maintaining slower speeds. This is in direct contrast to the present-day practice of operating conventionally driven slush pumps, which requires changing of fluid liners and increasing pump speeds with increased well depth. The application of mechanical multiple speed transmissions and hydraulic torque converter drives has made possible slower speed operation while retaining the same size liner at a considerably greater depth. A test was conducted to determine if a reduction in magnitude of pressure pulsations could be accomplished by the application of a torque converter drive. The results of the test show that for a particular situation pressure pulsations of a conventionally driven pump were reduced by 50 per cent. A hypothetical case was then considered in which it was assumed that the converter drive was replaced by a mechanical multiple speed transmission, and it was demonstrated that the pressure pulsations of the conventionally driven pump were reduced by 16 per cent. In consequence of these demonstrations an analysis was developed to determine what increase in rated fluid end pressures of power pumps could reasonably be expected with a reduction of pressure pulsations. For a particular situation it was demonstrated that the rated pressure of a power pump could be increased approximately 10 per cent and 25 per cent, respectively, by the substitution of a mechanical transmission or a torque converter drive for a conventional clutch power takeoff.

†Presented before the Spring Meeting, Pacific Coast District, Division of Production, Los Angeles, California, May 10 and 11, 1951.

*Shell Oil Company, Long Beach, California.
**Shell Development Company, Emeryville, California.

THE purpose of the study was to develop a practical analysis of the effect of hydraulic torque converter drives on power slush pump characteristics, and to evaluate them on a basis of pressure pulsations by a comparison with conventional drives and mechanical multiple speed transmissions. Such transmissions would apply successively reduced speed ratios between pump and engine to permit the pump to operate without liner changes as the well depth increases.

For many years the direct-acting steam-driven slush pump was the most popular type for use in the oil fields. As improvements were made in the construction of the power slush pump and a better understanding of its operation was developed, however, it became competitive economically as well as operationally to the steam pump. Unfortunately, operators failed to recognize that the power pump was an almost entirely different piece of equipment that brought with it completely altered fluid flow characteristics. Until these differences have been recognized and fully understood, the operator cannot expect to replace the direct-acting steam pump with a power pump and obtain completely satisfactory performance.

The fluid ends of both types of pumps are alike, generally being of the reciprocating, double-acting type that includes a liquid cylinder, piston and rod, suction and discharge valves, and piping connections for the suction and discharge chambers. In type of drive the pumps differ completely, however. The driving mechanism for the direct-acting steam pump generally consists of a conventional slide-valve engine in which the steam piston is directly connected to the fluid piston by the piston rod. In contrast to this the power pump, by universal usage of the term, has come to mean one which is powered by an external prime mover through a drive system consisting of reduction gears, crankshaft, crosshead, and connecting rod.

The two pumps with their radically different types of drives have correspondingly very different characteristic flow curves. Fig. 1 shows the flow characteristics of a direct-acting duplex steam pump, which is actually two pumps interconnected in such a manner that the motion of the piston rod of one operates the steam valve of the other. Theoretically, a direct-

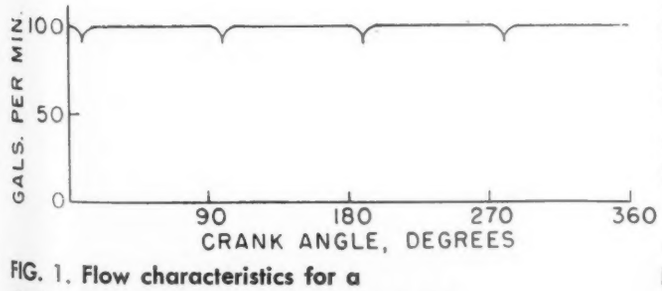


FIG. 1. Flow characteristics for a double-acting duplex steam-driven pump.

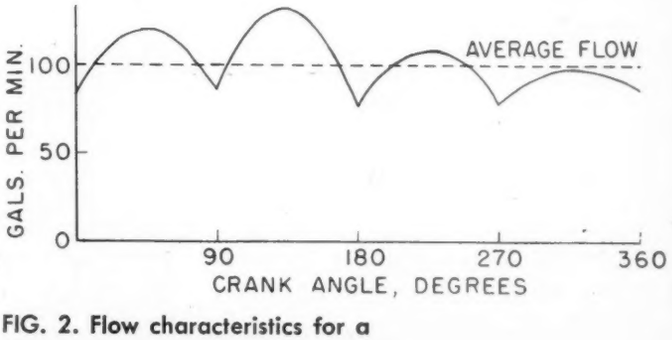


FIG. 2. Flow characteristics for a double-acting duplex power pump.

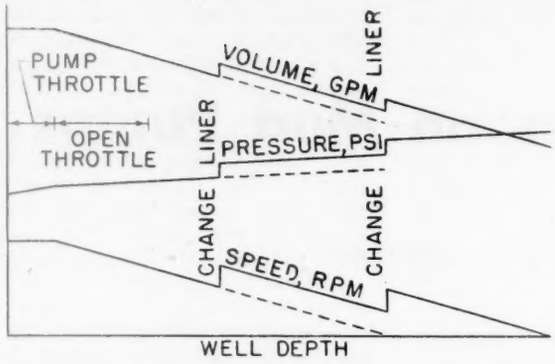


FIG. 3. Performance characteristics of a direct-acting steam pump as a function of depth.

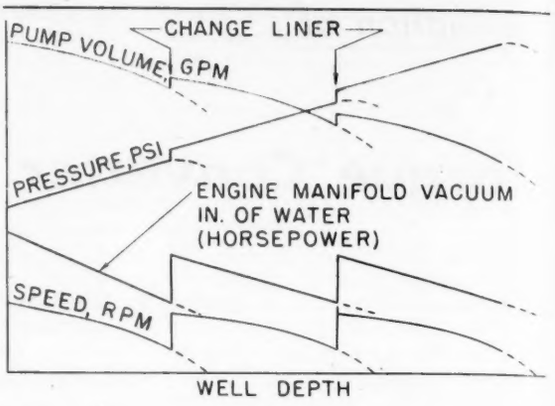


FIG. 4. Performance characteristics of a power slush pump as a function of depth.

acting steam pump maintains steady flow and a constant pressure, and because it is not greatly affected by the influences of the inertia of moving parts, the actual flow curve conforms closely to the theoretical curve.

In contrast, the power pump has certain flow and acceleration characteristics that are modified by the details of design, and that are not changed by the pumping system. Whereas the direct-acting pump adapts itself to a considerable extent to the characteristics of the pumping system, a power pump has no such flexibility and labors to make the flow in the entire system correspond to its particular flow pattern. Fig. 2 shows a typical flow curve for a duplex double-acting power pump. The flow pattern resembles a sine plus cosine curve, but is distorted due to the effect of angularity of the moderate-length connecting rod and the volume of fluid displaced by the piston rods. The amount of this distortion depends upon the ratio of the length of connecting rod to the length of crank, and the difference between head end and crank end piston areas resulting from the piston rod consideration. This distortion effect causes the periodic variations in the combined flow curve, which has the four peaks: Medium, high, medium, and low.

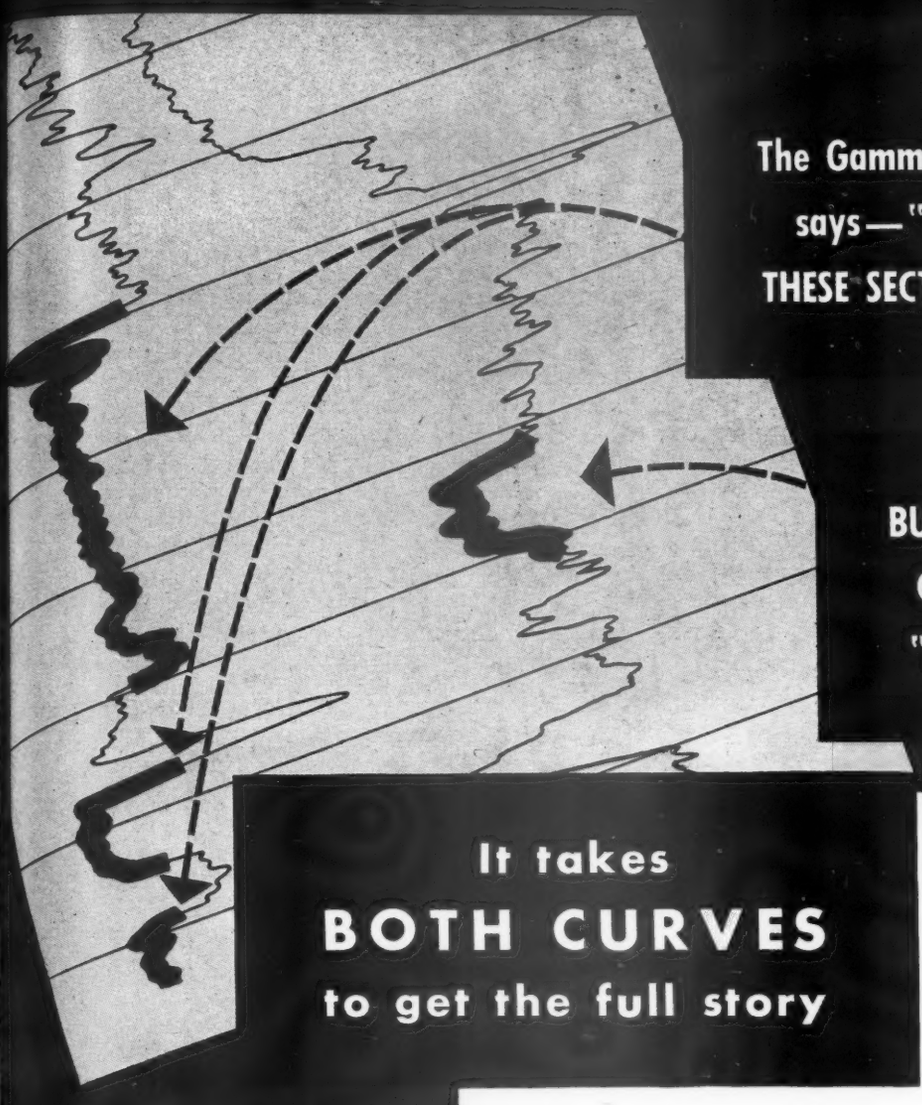
In analyzing the pressure fluctuations inherent in the power pump it is usually found that the rate of change rather than the amount of change of fluid flow is responsible for the pulsations. As the maximum rate of change fluid flow is proportional to the product of the pump speed and the greatest slope of the combined flow curve, variations of either will affect the pressure pulsations accordingly. This is accomplished in the triplex pump by smoothing out and reducing the maximum slope of the combined flow curve with an additional cylinder.

Now comes an important concept that is seldom recognized by the operators of power slush pumps. For two pumps having different size liners and operating at the same output, the one with the smaller size liner and higher speed will have considerably increased pressure pulsations. It has the same total flow variations as the slower pump with the larger liners, but with the difference that it takes place more frequently. Thus the rate of change of fluid flow is greater for the smaller higher speed pump and consequently the fluctuations in pressure will be greater.

Power pumps as they are operated today usually follow much the same pattern of application as the direct-acting steam pumps. The similarity of operation between the two types of pumps is illustrated in Figs. 3 and 4. As the well depth increases with a corresponding increase in pressure each pump is forced to slow down until at some depth the liner must be changed to a smaller size or the pump will stall. With each change in liner size the pump again speeds up, and, in the case of the power pump, each increase in speed is accompanied by a corresponding increase in magnitude of pressure pulsations. The application of mechanical transmissions to power slush pumps has offered the advantage of operating at slower speeds while retaining the same size liner without stalling the pump. Another more recent development has been the application of hydraulic torque converters, which, for many years, were considered unadaptable to slush pumps. A better understanding of converter application and mechanical improvements in the power slush pump have eliminated many of the earlier objections, however. The converter on a slush pump offers several valuable features, probably the most familiar one being that it permits the engine to operate at its most efficient speed while the pump automatically adjusts itself to maximum discharge volume, thus obtaining relatively constant hydraulic horsepower at its discharge.

Recently, a test was conducted to determine if a torque converter drive would reduce power pump pressure pulsations by a comparison with a conventionally driven pump equipped with a necessarily smaller size liner. The test was conducted at a rig drilling $6\frac{1}{4}$ in. hole with $3\frac{1}{2}$ in. OD internal-flush drill tubing at a depth of 6063 ft. Seven-inch, 26-lb-per-ft casing had been set at a depth of 5725 ft. The No. 1 pump, which had a $7\frac{1}{4}$-in. liner and 16-in. stroke, was rated at 300 hydraulic horsepower, and was driven through a single-stage torque converter and chain drive by a 12-cylinder twin diesel engine rated at 290 combined brake horsepower. The No. 2 pump, which had a 6-in. liner and 14-in. stroke, was rated at 280 hydraulic horsepower, and was driven through a clutch power takeoff and V-belts by two 6-cylinder gas engines rated at 180 bhp each. Unfortunately, the two pumps were not alike either in length of stroke or prime mover. In a practical sense, however, the conditions of the test were quite representative of an actual drilling situation. The necessity of using 6-in. liners in the No. 2 pump was probably indicative of the size liner that would have been required by the No. 1 pump had it been conventionally driven at that depth. This situation is illustrated in Fig. 5, which compares the performance curve of a converter driven pump with a single size liner to that of the same size liners.

Each of the two pumps was tested individually by replacing the mechanical pressure gage with a Statham pressure pickup and operating the pumps at pressures ranging from 300 to 1100 psi, inclusive. The drilling fluid consisted of 74 lb per cubic foot



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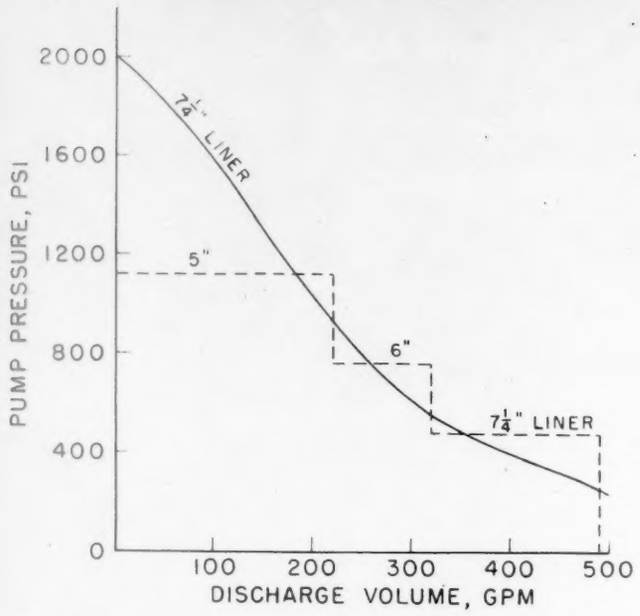

FIG. 5. Performance curves for a 7¼-in. by 12-in. power slush pump with a torque converter drive and one size liner, as compared to the same pump with a conventional drive and various size liners.

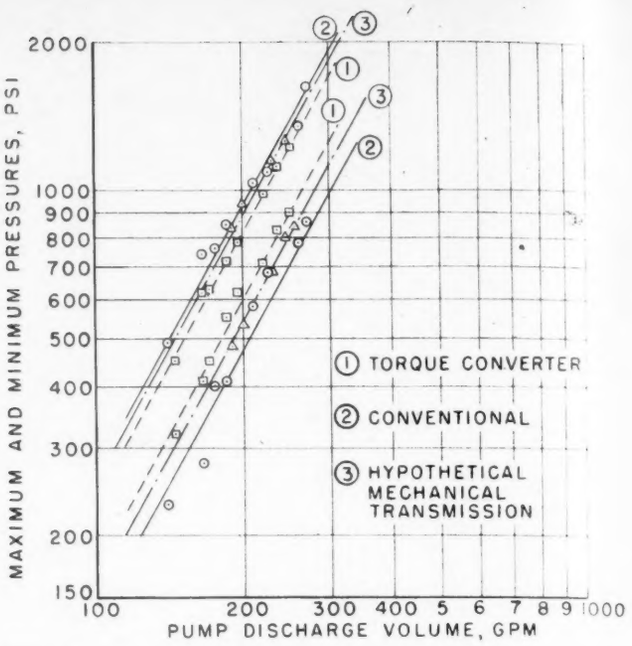

FIG. 6. Curves showing maximum and minimum pressures for slush pump using conventional drive, and one using torque converter and hypothetical mechanical transmission.

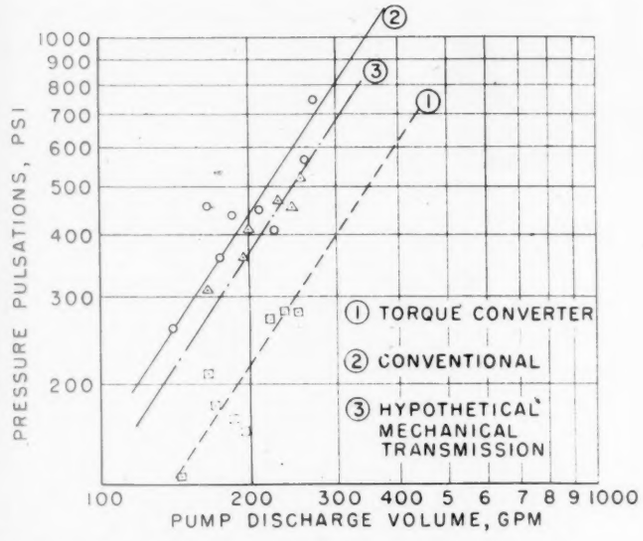

FIG. 7. Curves showing pressure pulsations for a slush pump using a conventional drive, a converter and hypothetical transmission.

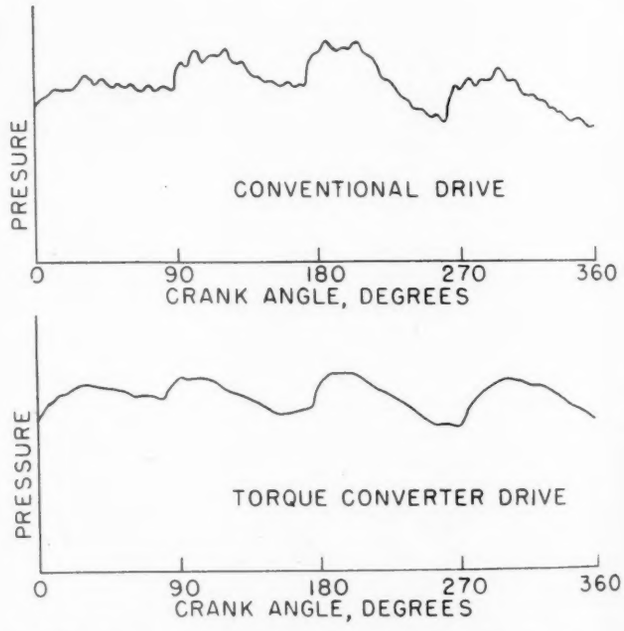

FIG. 8. A comparison of measured pressure traces of two power slush pumps, one using a conventional drive and the other a torque converter.

water base emulsion mud, which was circulated with the bit rotating off bottom. Results of the test are shown in Fig. 6 in which the maximum and minimum pressures recorded for one crank revolution are plotted for both pumps against calculated actual discharge volumes.

From Fig. 6 it is apparent that the pressure pulsations of the converter driven pump were considerably reduced, because both the maximum and minimum pressures for this pump, represented by the lines marked (1), fall within corresponding pressures for the conventionally driven pump, represented by the lines marked (2). The amount of this reduction, represented by the vertical distance between the variation lines marked (1) and (2) in Fig. 7, is approximately 50 per cent. Had the No. 2 pump been operating with a 16-in. instead of a 14-in. stroke, however, the slower speed probably would have reduced this figure somewhat. Nevertheless, the reduction of pressure pulsations was appreciable and led to an attempt to predict what the reduction in variation would have been if the No. 1 pump had been equipped with a mechanical transmission. In this connection, a theoretical analysis was developed by means of which maximum and minimum pressures,

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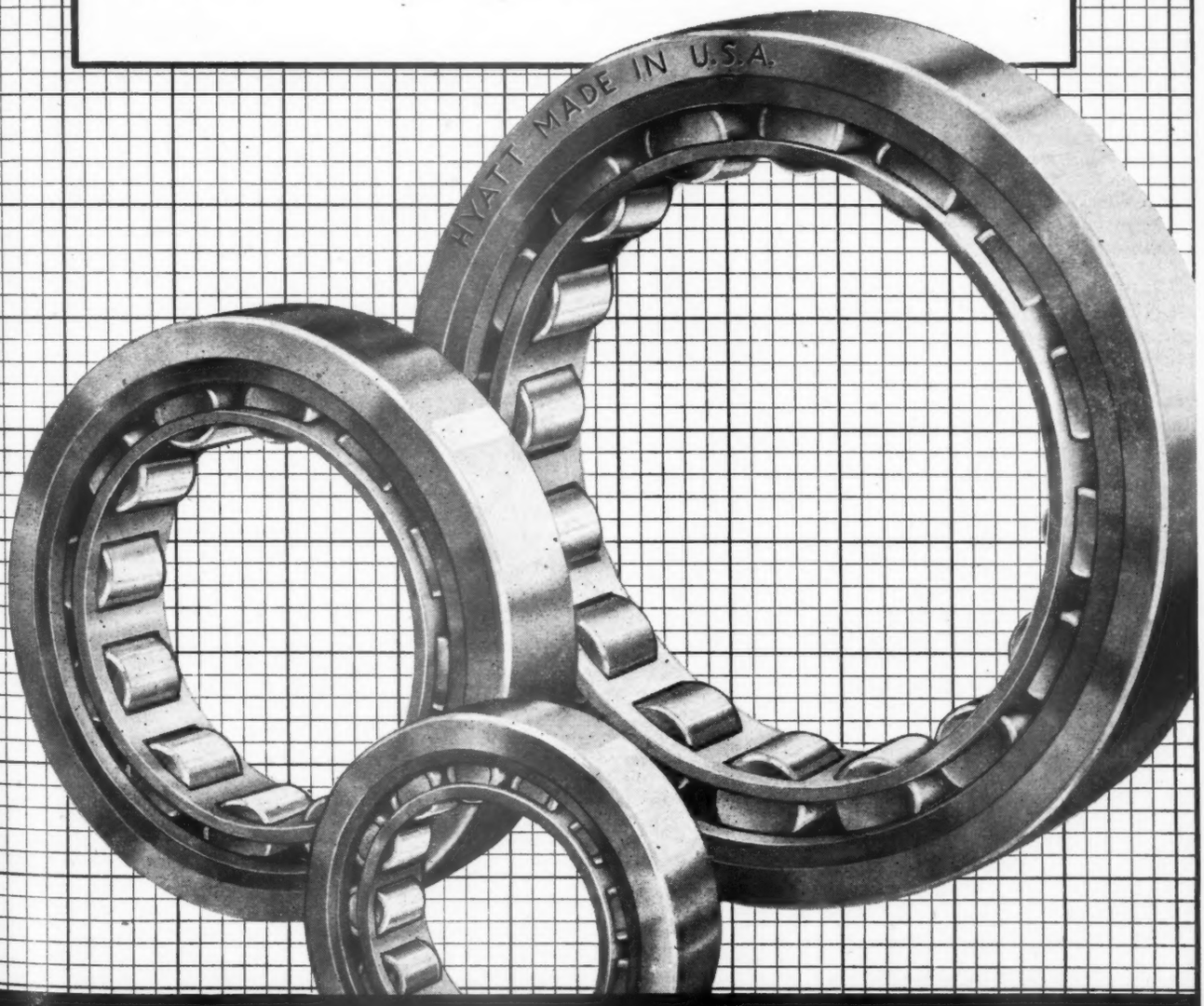

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represented by the lines marked (3) in Fig. 6, were calculated for the No. 1 pump assuming it was equipped with a mechanical transmission instead of a converter. As anticipated, these curves fell inside those for the conventional drive, and, more importantly, outside the curves for the converter drive. Fig. 7 shows that the pressure variations of the conventionally driven pump could have been reduced by 16 per cent with the application of a mechanical transmission, as opposed to the previously demonstrated 50 per cent reduction obtained by the converter drive.

The reduction of the pressure pulsations corresponds to the general alteration of the pressure curve when a converter drive is applied to a slush pump. The pump is no longer required to conform without variation to the constant speed characteristics of the prime mover, but may, with the elimination of the positive mechanical drive, develop relatively independent operating characteristics of its own. What happens is that the individual operational cycle of the crank is changed from a constant to a varying angular velocity. This is illustrated to good advantage in Fig. 8 in which it is evident by comparison of the manner in which the pressure curve of the converter driven pump is altered. Maximum pressures are lowered and minimum pressures are raised, while the duration of comparable parts of the cycle is not constant. In general, the pressure curve for the conventionally driven pump is characterized by peaked maximum pressures and a sharply fluctuated rise and fall of pressures between peaks, while that for the converter driven pump is a much smoother curve characterized instead by rounded maximum pressures and a gentle rise and fall of pressures between them.

If one considers the effects of torque converter drives on stresses in parts of the engine and drive mechanism, it will be noted that appreciable mechanical improvements are obtained, accruing from at least two different causes:

(1) Reductions in peak pressures obviously reduce peak stresses in the parts.

(2) Smoothing of the pressure curves reduces shock loads and high momentary accelerations, and will appreciably improve fatigue life of parts.

The reduction of pressure pulsations will permit raising of the rated pressures on the fluid end of the pump. This can be illustrated further as follows: Assume that a certain part in the pump drive such as a gear is designed on fatigue limit and sub-

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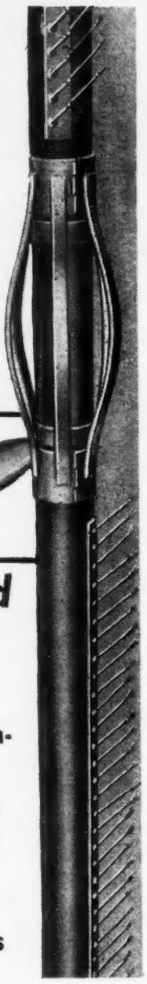

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jected to stresses that are directly proportional to the pressure pulsations in the pump. Then

$$S_{max} = k\,P_{max}$$

and

$$S_{min} = k\,P_{min}$$

where S_{max} and S_{min} are the maximum and minimum stresses in the part, respectively;
P_{max} and P_{min} are the maximum and minimum pressures; and k is a constant. Then
$S_r = (S_{max} - S_{min})/2$ = amplitude of fluctuating stresses
and
$S_m = (S_{max} + S_{min})/2$ = mean stress
then

$$\frac{S_r}{S_m} = \frac{1 - S_{min}/S_{max}}{1 + S_{min}/S_{max}} - \frac{1 - P_{min}/P_{max}}{1 + P_{min}/P_{max}}$$

One can now, according to Timoshenko and MacCullough, plot a curve for computing a new maximum allowable fluid pressure as in Fig. 9. Operation under the line AB assures against the possibility of exceeding safe pump operation and shows that with a decrease in maximum pump speed and a corresponding decrease in pressure pulsations the fluid and rated pressure may be increased.

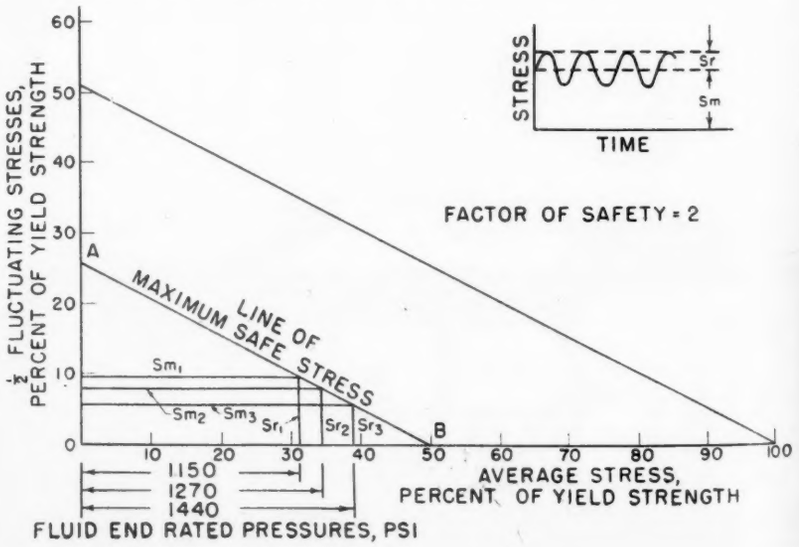
The values chosen for the ratio of P_{min}/P_{max} are those shown in Fig. 6 and the corresponding ratios of S_r/S_m were calculated from them. If the type of steel for the gear is known, then curves similar to the one in Fig. 9 can be plotted and the amount calculated by which fluid end pressures may be increased and yet maintain the same degree of safe pump operation. Values for the ratios of P_{min}/P_{max} were 0.515, 0.615, and 0.738, respectively, for the conventional, transmission, and converter drives. The corresponding ratios of S_r/S_m were, therefore, 0.320, 0.239, and 0.151 which resulted in values for S_m, the maximum safe average stress of the gear of 31.2, 34.4 and 38.9 per cent of the yield strength. Therefore, the rated pressure of the conventionally driven No. 2 pump, which was approximately 1150 psi using a 6-in. liner, could have been increased by the ratios of 34.4/31.2 and 38.9/31.2. This would have resulted in new rated pressures of 1270 psi and 1440 psi, respectively, for this pump had it been operating with larger size liners and at slower speeds made possible through the application of a mechanical transmission or a torque converter.

Conclusions

A direct-acting steam pump adapts itself to the characteristics of the pumping system, whereas a conventionally driven power pump has no such flexibility and labors to make the flow in the entire pumping system correspond to its particular flow pattern. With a torque converter drive, however, a slush pump acquires a new degree of flexibility and by the elimination of the positive mechanical drive it is no longer required to conform rigidly to the constant speed characteristics of the prime mover. Instead, new and relatively independent characteristics are developed resulting in an entirely altered pressure curve.

In a power pump pressure pulsations are a function of the rate of change of fluid flow, which, in turn,

FIG. 9. Curves based on Timoshenko analysis demonstrating the calculation of new rated pressures for a slush pump.



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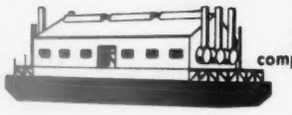

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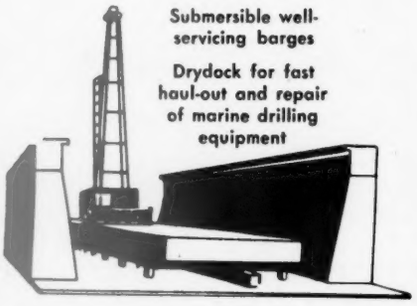

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is proportional to pump speed. Therefore, reducing the speed of a power pump will correspondingly reduce pressure pulsations.

A torque converter was found to reduce pressure pulsations by approximately 50 per cent when compared to a conventionally driven pump, which, for the particular situation considered, was operating at higher speeds as a result of the necessary reduction in liner size. A theoretical analysis, in which it was assumed that the converter was replaced by a mechanical transmission, showed that the pressure pulsations of the conventionally driven pump would have been reduced by 16 per cent.

The reduction of pressure pulsations will permit raising the rated pressures of the fluid end of the pump. For a particular situation it was demonstrated that the rated pressure of a conventionally driven pump could be increased approximately 25 per cent by the application of a torque converter, and by approximately 10 per cent by the application of a mechanical transmission. Such increases illustrate the advantages to be gained by maintaining larger size liners and operating slush pumps at slower speeds.

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COMMENTS ON: INVESTIGATION OF TORQUE CONVERTER DRIVES ON MUD PUMPS

By Nicholas A. D'Arcy, Jr.,
Mechanical Engineer
Huntington Park, California

"David F. Toomey and Ernest G. Chilton are to be congratulated on the care and detail in which they conducted their study of the application of torque converter drives to mud pumps. Their careful instrumentation and analytical analysis of the problem justifies the use of hydraulic torque converters for this particular purpose and substantiates the rule of thumb decisions and careful tabulation to maintainance costs made by drilling contractors who first applied torque converters to slush pumps in California. It further justifies the liberalization of torque and pressure standards by many of the slush pump manufacturers.

"There are but two words of caution I would like to insert: The first being that considerable study should be given to the overall speed reduction ratio between the prime mover and the slush pump in order to obtain maximum hydraulic horsepower over the normal operating range. The second, that the torque converter should not be considered as a means of eliminating all of the liner size changes. The torque converter installed in a slush pump drive will, of course, reduce the number of liner size changes required, but not necessarily eliminate them."

By Gene Graham
Rocky Mountain Drilling Company
Los Angeles, California

"My comments on this paper will necessarily be from a layman's viewpoint, and I appreciate the opportunity of making a few remarks:

"1. **The importance of pumping equipment.** As a member of a drilling contracting company I am well aware of the tremendous effect on drilling efficiency to be obtained from proper application of power to pumps.

"2. **Cost Reduction.** The reduction of all elements of drilling costs is a problem of vital importance to all of us — contractors and operators alike. While this paper does not deal directly with costs, the implication exists that costs, generally, will be reduced by torque converter application.

"3. **Care of Equipment.** With the tightening labor market, due to increased industrial activity in all branches of business, means must be found to minimize the need for the

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close attention drilling equipment now requires. If torque converters will permit more economical operation of the prime movers as well as the pumps, and such seems to be the case, they are worth the investment."

By A. G. Fraser,
Republic Supply Company,
Los Angeles
G. W. Gutekunst,
Gardner-Denver Company,
Los Angeles

"Toomey and Chilton have presented an excellent paper on a subject that has become of increasing interest to the oil industry due to the decrease in the use of steam equipment and the more common use of power equipment for drilling. They have approached the subject from a standpoint that is unique and different in that the application of torque converters to mud pumps has been in the past primarily based on practical experience built up over a period of years. The problem has seldom been approached from a technical or theoretical standpoint.

"About 15 years ago when power rigs began coming into prominence, the need for more flexibility in power pump operation was recognized. Suitable transmissions and torque converters were not available with the result that two speed, line shaft, jaw clutch type chain drives were used in order to cut down high pump speeds, and, consequently, the number of liner reductions. Experience indicated that this type of approach was a step in the right direction.

"Later, several types of transmissions made multiple pump speeds available to the operator. Experience again indicated that the approach in general was correct. Finally the use of torque converter pump drives made an infinite number of speeds available to the operator. The initial application of torque multiplication devices had been more commonly applied to cementing and remedial pumps, in that torque multiplication of high magnitudes were and are used to obtain high pump pressures and relative low volumes for a short period of time. This type of work is not the subject of Toomey and Chilton's paper; however, the experience gained in these extreme cases of torque multiplication was practically applied in a lesser degree to mud pump drives.

"Practical experience bears out, in the main, the conclusions reached in Toomey and Chilton's paper. We would like to remark that in order to obtain the full advantages of using a torque converter mud pump drive, it is imperative that engine, torque converter, and pump are so selected as to hold as closely as possible to the most efficient operating range of each of the components.

"We would also like to remark that the operator must recognize that serious static overloading may be applied to the pump if operation is outside of the high efficiency range of the torque converter. This, as previously stated, is not serious for short periods of operation but if continued over long periods of time, excessive wear factors must be taken into consideration.

"It is interesting to note that experience has indicated that better than normal operating life can be expected from engines, chains, sprockets, and pumps in a torque converter driven unit even though the pump may be loaded to points not normally recommended. This factor may be explained by the high factors of safety normally used by pump manufacturers in mud pump design. Elimination of shock loads, as described in the paper, apparently makes a proportion of this factor of safety unnecessary.

"In summary, we feel that practical experience over a period of years would indicate that Toomey and Chilton's conclusions have a definite basis of fact." ★ ★ ★

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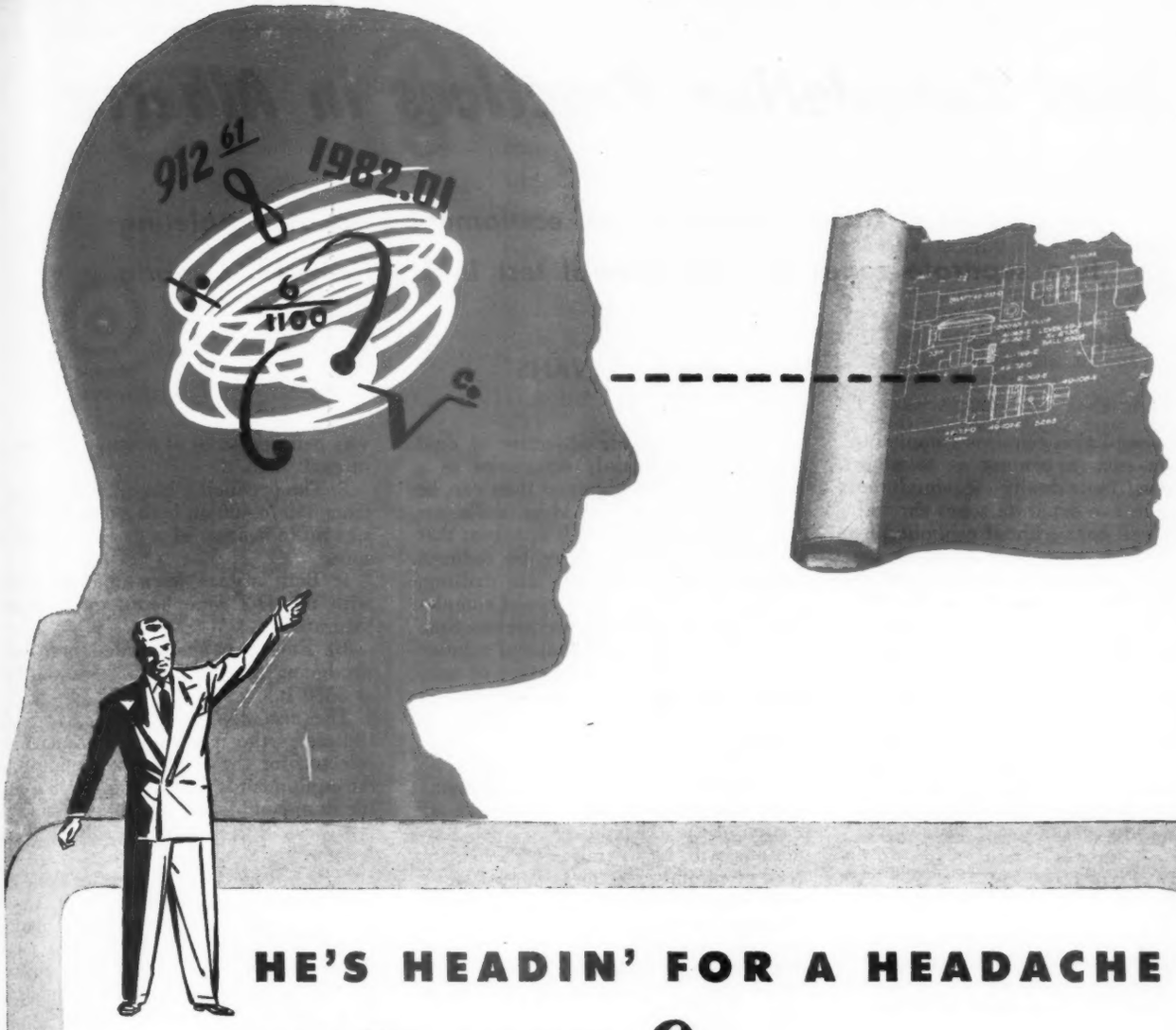

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Dual Completion Practices in Alberta†

An account of factors analyzed and equipment used in completing two separate zones in experimental test in Stettler field, Canada

PAUL C. EVANS*

DUAL completion requires completing a well in such a manner as to allow production, individually or simultaneously, from two separate zones through a single well bore without commingling of fluids. This type of completion became very prominent in various parts of the United States during World War No. 2 when there was a grave shortage of tubular goods. Since that time, it has become a recognized method of completion and various manufacturers produce equipment for this specialized purpose.

If dual completion is contemplated in a well in a field it is essential to minutely review all available information concerning the area. Some of the factors that should be closely scrutinized are as follows:

1. Casing program, especially oil string size.
2. Cementing procedure to insure excellent cement sheath around casing.
3. Completion procedure to determine method of perforating casing, acid treatment, etc.
4. Types of producing formations.
5. Geological interpretation of the producing sections.
6. Producing ability of each zone and type of fluids.
7. Reservoir producing mechanism.
8. Depth to and between producing sections.
9. Chemical and physical characteristics of the produced crude oil from each zone.
10. Corrosiveness of each produced fluid.
11. Bottom hole pressure and temperature of each zone.
12. Paraffin content of the produced oil.
13. Analysis of sub-surface crude oil sample from each zone.
14. Producing gas-oil ratio of each zone.
15. Expected producing life of each zone.

If the above factors are analyzed, a decision can be made as to the type and kind of dual producing equipment to use on any particular well. There are numerous manufacturers of this specialized type of equipment and all types have their merits.

Of course, the big objective of dual completions is mainly economics as a lower cost can be obtained than can be achieved through individual wells for each productive zone. It is apparent that the major costs that may be reduced through dual completions are drilling, casing, and tubing. This type of completion is very attractive at the present time due to the alarming shortage of tubular goods. An advantage of this type of completion that appeals to management is the deferred investment in capital as compared to two wells. In some areas it is doubtful if dual completions will be less expensive than single completions to the abandonment stage but the major portion of the expenditure on dual completions will be operating expense instead of capital investment. Under some conditions the economic life of a dually completed well may be extended beyond zone completions because each zone may be profitably produced at a lower rate than would be profitable for a single zone.

The Alberta Petroleum and Natural Gas Conservation Board granted the Canadian Gulf Oil Company permission to dually complete two wells in the Stettler field as an experimental test for this field of the adaptability of dual completion techniques and equipment to conditions prevalent in Alberta. The preliminary data available on the field when it was selected for the dual completion experiment were as follows:

1. The oil string casing size was 7-in. OD and a good cement job was being obtained by the use of scratchers and centralizers.
2. A Green Shale section of approximately 100 ft separated the two productive zones.
3. The D-2 and D-3 zones are highly productive with flowing potentials ranging from 1000 to 3300 bbl of oil per day.
4. There was no evidence of paraffin deposition, however, it was probable that minor accumulations would occur during the life of the well.
5. There was hydrogen sulfide present in the produced crude oil but it was not believed that sub-surface corrosion would be severe.
6. The pressure differential between the two zones was approximately 100 psi and the bottom hole temperature was relatively low at 146 deg.
7. The reservoir producing mechanism was believed to be of a water drive type in each zone.
8. The producing gas-oil ratios ranged from 350 to 400 on both zones and there was no indication of a gas cap in either zone.
9. Both crudes were undersaturated with the D-2 zone being quite undersaturated.
10. Relatively shallow depths to each producing zone, D-2 at 5200 ft and D-3 at 5350 ft.

The accompanying drawing, Fig. 2, illustrates the mechanical arrangement selected for these dual completions. As the equipment is identical for both wells, the dual completion procedure for CPR Havig No. 8 will be used for illustration. Two production type packers were set at 5282.5 ft and 5161.75 ft after the 7 in. OD casing was set at 5353 ft on top of the D-3 porosity and perforated opposite the D-2 with 336 jet shots. The total depth of the well is 5363 ft. The producing equipment was run as tabulated, from the bottom up:

1		2⅜ in. OD 10 ft perforated anchor
2	jts	2⅜ in. OD tubing
3		seal nipple between
3		spacer nipples
3	jts	2⅜ in. OD tubing
4		2⅜ in. OD tubing nipple
1		changeover flow tube
1	jt	2⅞ in. OD tubing
1		2⅞ in. OD safety joint
1		2⅞ in. OD x 2 ft tubing nipple
1		2⅞ in. landing nipple and removable side door choke
162	jts	3½ in. OD tubing
3		3½ in. OD tubing nipples

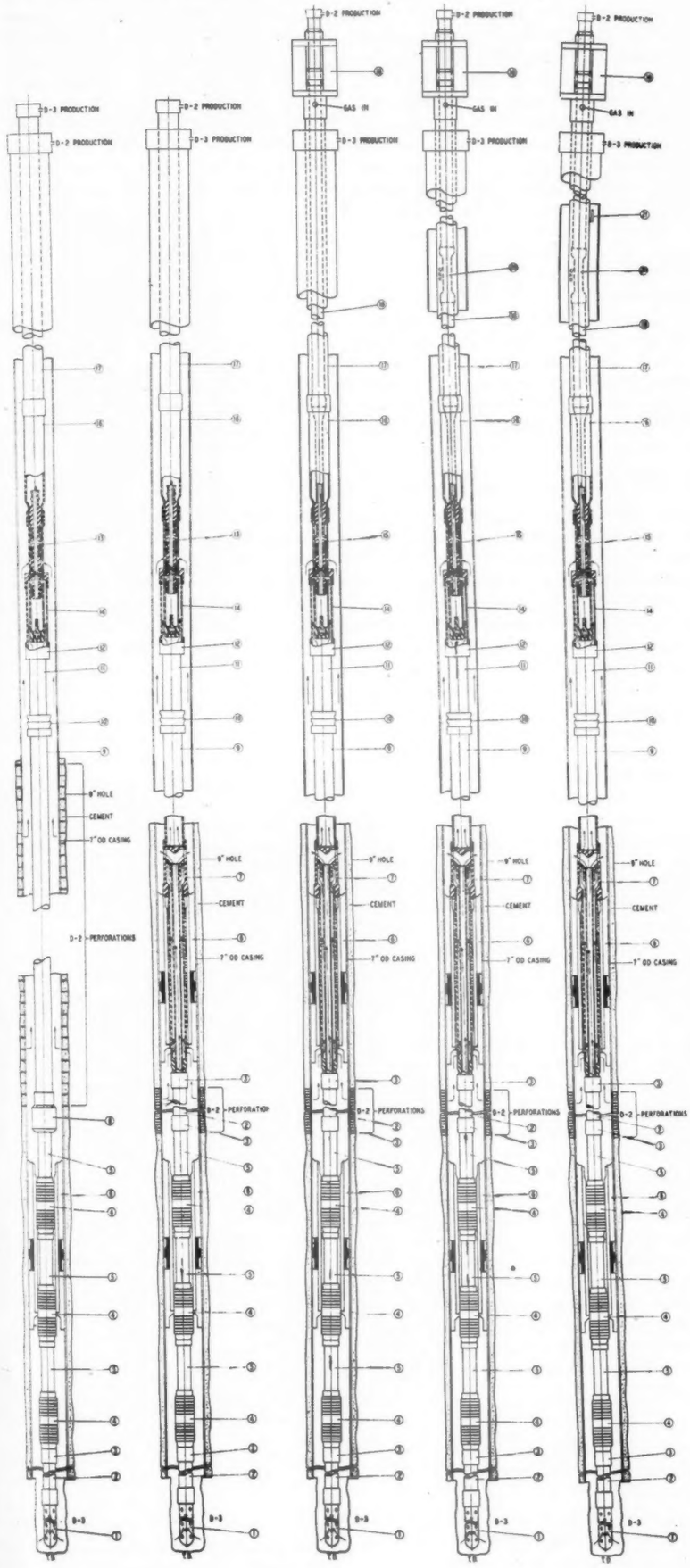
The lengths of the various assemblies assured the proper spacing of the seal nipples so that simultaneous seals would be provided in both packers. The tubing string was suspended and packed off in a flange type tubing head.

Referring to Fig. 2 of the diagram, it will be noted that the 3 packing seals with spacers 10 in. long are so placed as to insure that at least one packing seal or equivalent is within the sealing section of the lower packer. Thus the D-3 production is allowed to enter the tubing and is kept separate from the D-2 production which enters the annular space between the tubing and the casing above the lower packer. The upper packer was installed in order to enable the use of a changeover flow tube which seats

†Presented to the Oilfield Technical Society, January, 1951.

*Chief engineer, Canadian Gulf Oil Company.

FIG. 1 FIG. 2 FIG. 3 FIG. 4 FIG. 5



BILL OF MATERIAL

1. 2⅜-IN. OD EUE 8 RD THD x 8-FT MUD ANCHOR
2. 2⅜-IN. OD EUE 8 RD THD TUBING
3. 2⅜-IN. OD EUE 8 RD THD x 10 RD THD SUB CPLG FOR BAKER SEALING NIPPLE (No. 13)
4. BAKER MULTI-V TUBING-SEAL NIPPLE (No. 13)
5. BAKER SPACER NIPPLE WITH CPLG 10 RD THD
6. BAKER MODEL "D" RETAINER PRODUCTION PACKER (No. 87) FOR 7-IN. OD 23 LB CASING
7. BAKER MODEL "D" ANCHOR-TYPE CHANGE OVER FLOW TUBE WITH 2⅞-IN. OD EUE 8 RD THD BOX UP AND 10 RD THD PIN DOWN
8. SEALING NIPPLE LOCATOR SUB 2⅞-IN. OD TOP
9. 2⅞-IN. OD EUE 8 RD THD TUBING (1 JOINT)
10. BAKER SAFETY JOINT WITH RH THD FOR 2⅞-IN. OD EUE 8 RD THD TUBING
11. 2⅞-IN. OD x 24-IN. LONG EUE 8 RD THD NIPPLE
12. 3½-IN. OD EUE 8 RD THD x 2⅞-IN. OD EUE 8 RD THD SUB CPLG
13. 2½-IN. OTIS TYPE "K" REMOVABLE SIDE DOOR CHOKE
14. 2½-IN. OTIS TYPE "K" LANDING NIPPLE ADAPTED FOR USE WITH 2-IN. TBG INSIDE 3-IN TBG
15. 2½-IN. OTIS TYPE "K" REMOVABLE SIDE DOOR CHOKE ADAPTED FOR USE WITH 2-IN. TBG INSIDE 3-IN. TBG
16. 2⅞-IN. OD x 3½-IN. OD OTIS TYPE "J" SLOT NIPPLE
17. 3-IN. OD EUE 8 RD THD TUBING
18. 2⅜-IN. OD EUE TBG WITH TYPE "S" HYDRIL JOINT
19. TYPE "H" FLOW HEAD
20. FLOW VALVE ON 1½-IN. x 2 FT NIPPLE WITH HYDRIL JOINT
21. FLOW VALVE ON 3½-IN. OD TBG

in the packer and provides a seal separating the annular space above the upper packer from that below. The D-3 production coming up the tubing enters an inner channel of the changeover flow tube at its lower end and emerges from the side ports above the packer into the annular space between the tubing and casing. The D-2 production in the annular space between the packers enters the changeover flow tube through side ports below the upper packer, flows up an annular channel of the changeover flow tube, emerging into the tubing. The changeover, permitting production of D-2 zone through tubing, was installed because the severe undersaturation of the D-2 zone oil indicated pumping would later be required to maintain D-2 production.

The arrangement so far described permits the production of D-3 oil through the annular space and D-2 oil through the tubing. A left hand thread safety joint was included in the flow string above the upper packer to enable the backing-off of tubing in case of possible

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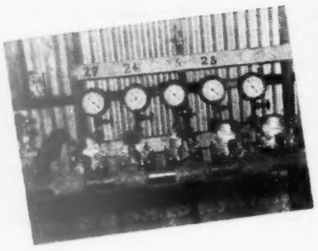
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future pulling difficulties. Above this a removable side door choke and landing nipple was installed so that flow from either zone could be directed individually through the tubing for the purposes of original kick-off or subsequent bottom hole pressure tests. A 3½ in. by 24 in. tubing nipple is suspended from and attached to the midpoint of the landing nipple by means of a 3½ in. OD coupling screwed onto threads on the approximate mid-section of the landing nipple. The lower end of the landing nipple extends down into the 3½ in. by 24 in. tubing nipple to provide operating space for the side door choke.

This upper end of the landing nipple is connected to the 3½ in. OD tubing string by means of a 2⅞ in. coupling, having one end threaded both internally and externally, and a standard 3½ in. coupling. This upper section of the landing nipple has 4 ports near the juncture with 3½ in. by 2 ft nipple below. The lower section of the landing nipple has ports also near the point of threaded connection with the 3½ in. by 2 ft nipple but within this nipple. A sliding choke assembly within the landing nipple has two sets of ports so spaced and separated by sealing rings that when in the down position its upper ports are opposite the upper landing nipple ports, and annular or D-3 production can enter the tubing while its lower ports are sealed off against a blank section of the landing nipple. When in the upper position, the lower ports of the sliding choke are opposite the lower landing nipple ports and its upper ports are sealed off in the upper section of the landing nipple, thereby permitting tubing or D-2 production to enter the upper section of tubing. The sliding choke is run and moved as desired by means of tool on a wire line. It is to be noted that with the sliding choke in the up position, the well can, if desired, be produced from both zones simultaneously, but the production from the two zones is separated at all times.

The first step in completion activities, after the tubing was run and surface connection installed, was to swab the tubing to induce flow from either or both zones. After flowing through both tubing and casing, the sliding side door choke assembly was run and set in the landing nipple to separate the production from the two zones. The tubing was opened up and the tubing pressure bled down to zero indicating that D-2 and D-3 had been successfully separated but that the tubing would have to be swabbed to enable the D-2 to flow. During swabbing operations the casing pressure remained constant at 400 psi. It was necessary to acidize the D-2 zone with 1000 gal of 15 per cent hydrochloric acid with maximum tubing pressure of 2400 psi and casing pressure remained constant at 400 psi. Swabbing operations induced flow from the D-2 zone and now both zones were capable of flowing.

In the first part of the segregation test, the D-3 zone was produced through the casing for 298 bbl of oil in 12 hours. During this test, the casing pressure dropped from 450 psi to 240 psi and built back up to 350 psi after the well was shut in. The gravity of the produced oil was 28.7 API at 60 F and the GOR for the test was 690 cu ft per barrel. The tubing pressure remained constant at 330 psi during the test.

In the second part of the test, the D-2 zone was produced through the tubing for 12 hours flowing 348 bbl of oil. Throughout the test, the pressure in the casing remained constant at 350 psi. The tubing pressure dropped from 325 to 45 psi and then levelled off at 90 psi until shut in, after which it built up to 325 psi. The oil produced through the test had a gravity of 24.1 API at 60 F and had a cut of 16 per cent drilling mud and acid water. The GOR during the test was 304 cu ft per barrel. Consideration of the above factors, particularly the stability of well head pressures from either zone while the other was being produced, and the stability of casing pressure while acidizing the D-2 zone through the tubing, conclusively indicated successful segregation of the production from the two zones.

Flowing bottom hole pressure tests were taken on CPR Havig No. 8 of both the D-2 and D-3 zones. Both zones were flowed individually through the tubing by manipulation of the side door choke. The test of the D-2 zone was quite comparable to individually completed D-2 wells but the productivity index of the D-3 zone was lower than normal; this was believed due mainly to pressure reductions due to changing the flow direction of D-3 crude. The D-3 crude moves directly into the tubing anchor, crosses into the annulus at the changeover flow tube, passes through the ports in the landing nipple, and emerges into the tubing again through the ports in the side door choke.

Both of the experimental dually completed wells, CPR Havig No. 8 and N. J. Ellis No. 5, have been successfully completed and mechanical segregation of the two zones has been accomplished. Some problems were experienced on both wells and the main difficulties are discussed below:

1. Trouble was experienced with shearing loose from the side door choke when it was first run on the initial well. Subsequently, the wire line was broken and upon pulling tubing, it was discovered that there was not proper clearance between the side door choke running tool and the specially constructed J-slot on top of the landing nipple. This was remedied by increasing the possible clearance by removing a small portion of the steel in the landing nipple.

Also the unfamiliarity with the spe-

oOo

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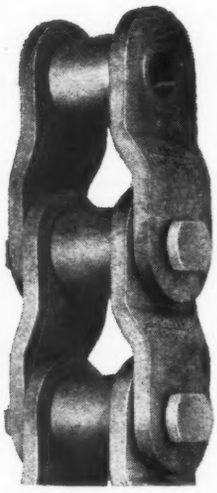

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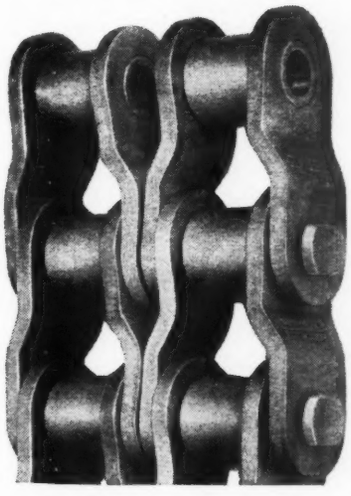

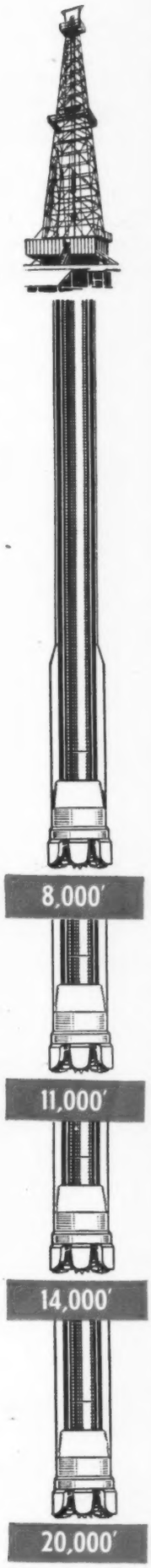

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cialized tools by the engineering department personnel contributed to the initial failure. Since that time the position of the side door choke has been changed many times and on a few occasions it has been retrieved to the surface for inspection without any difficulty.

2. One problem of recovering the "dead" oil in the annulus after initially displacing drilling fluid in the well caused considerable concern and was not anticipated. The D-3 zone in this area is quite prolific and has a high flowing bottom hole pressure at high rates. This would not allow the "dead" oil to bleed into the tubing string and be replaced by gas and live oil. Undoubtedly, production would have eventually replaced the oil in the annulus by continuous flowing but it would have taken an excessive amount of production. This trouble was alleviated by injecting high pressure gas from a nearby well into the casing for kick-off purposes.

3. On one well initial segregation was not accomplished and after checking the operation of the side door choke, the tubing was retrieved from the well. The position of the packers was checked by a specially designed tool and it was determined that the packers were approximately two feet farther apart than indicated on drill pipe measurement when the packers were originally set. Therefore, the bottom packing seals were not engaging the seats in the bottom packer. Three additional seal nipples and spacers were added to the tubing string and complete segregation was obtained when the tubing was re-run.

This error emphasizes the importance of extremely accurate measurements during the entire procedure of dually completing a well. All measurements should be checked and re-checked by competent personnel. Also, it is suggested that caliper measurements of the different pieces of equipment be made so that all clearances are definitely known. It is further suggested that a complete drawing be prepared showing all the pertinent data and measurements and kept available for future reference.

The attached drawing indicates other methods of dual completion and proved methods of artificial lift. The 3½ in. OD tubing used is sufficiently large to permit the running of smaller tubing inside, which would be connected to the top of the side door choke unit by the J-slot. Gas forced into the annulus between the tubing strings could be used to gas lift production from either zone. By use of internal flush joints on the inner tubing, a conventional type pump could be used to pump either zone through the inner tubing while gas lifting the other zone in the casing. Other possibilities include the use of a hydraulic pumping installation to pump one zone while flowing the other; conventionally pump each zone separately for 15 day periods; pump each zone simultaneously by using a specially designed two zone pump. The ingenuity of man will probably devise many other and better methods than the artificial lift plans mentioned above by the time artificial lift is needed in the Stettler field.

The dual completion of wells is an approved and satisfactory method of completion when thorough planning and study of the reservoir and mechanical characteristics are made. Some of the initial failures of dual completion fields were due to improper evaluation of these characteristics which doomed the project to dismal failure and caused considerable doubt by the oil industry as to whether this method of completion was practical.

The successful completion of the first two dually completed wells in the Stettler field warrants the following conclusions even though the production stage is still in its infancy:

1. That mechanical segregation of the two zones has been effected and the wells are capable of producing from two separate reservoirs at the same time, without commingling of the fluids.
2. That these wells have been equipped in such a manner as to be readily changed to artificial production by a number of standard methods.
3. That the experience gained by the operators has developed a practical appreciation of the problems to be expected in dually completing wells.
4. That the initial investment was less then it would have been if two individual wells had been drilled and completed. ★ ★ ★

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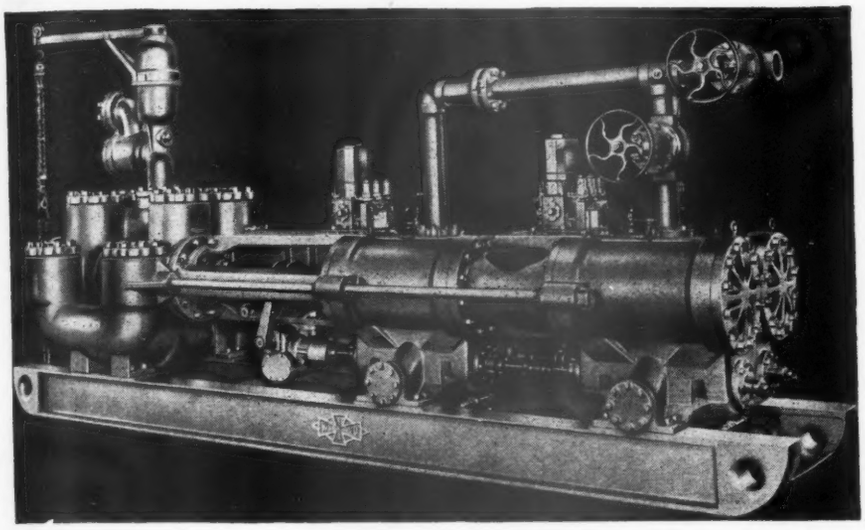

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Steam cylinders	16½" and 16½" x 20"
Hydrostatic test on steam cylinders	700 P.S.I.
Steam pressure, maximum working pressure	350 P.S.I.
Speed, normal R.P.M. each side	50
Steam pipe size to each cylinder	4"
Exhaust pipe size from each cylinder	4"
Main cylinder, Piston rod diameter	3¾"
Auxiliary cylinder, Piston rod diameter	3¼"
Water piston rod diameter	3⅛"
Water piston rod fitted for No. 6 A.P.I. piston	
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Material, solid one piece steel casting	
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TROUBLE SHOOTING†

Locating cause of trouble requires organized thinking as well as mechanical knowledge

HAROLD H. HALL*

THE terminology "trouble shooting" means locating the cause of the difficulty in order that permanent repairs can be made. The word permanent is used because of the comparative period of service obtained when repairs are made without locating and correcting the basic cause of the failure. This practice usually results in a repetition of the failure and this becomes expensive, in addition to increasing total time out of service on the unit.

Harold H. Hall

Many individuals qualified to do trouble shooting are hesitant to tackle an assignment of analyzing a failure due to the erroneous belief that this type of work requires an engineer. Actually, trouble shooting, in many cases, is very simple. In most problems the only requirement is a knowledge of the construction of the unit and the principles of its operation. Knowing these two factors, anyone who is qualified to make repairs on the unit can start at the beginning and follow through each step in the functioning of each part until the cause of the trouble is found.

This sounds easy and it is easy, provided the individual doing the work does not become excited and begin to jump to conclusions or begin to disassemble the unit before he does sufficient analyzing of the problem. A few examples will illustrate the facts stated. Cummins Diesels are referred to in the examples cited.

Begin with an example that is normally handled with ease in the fields. The engine suddenly stops and the operator is unable to start it by the usual procedures. Let us assume the operator checks the fuel supply in the tank and finds this to be O.K. He will then report the failure to the proper individuals and request that repairs be made. The individual assigned to this job must know the principles of operation of diesel engines in general and the Cummins fuel system in particular. With this information he will know that any diesel requires:

1. Air to be introduced into the cylinders.
2. This air to be compressed until the increase in temperature is sufficient to ignite the fuel.
3. Proper quantity of fuel to be injected into the cylinder at the proper time.

If these three factors are even relatively close to specified values, the engine will at least operate with no load applied. As it was running before the sudden failure and won't start now, one of these requirements must be missing.

In trouble shooting, it is desirable to make the easiest checks first to save labor and time. The air intake can be easily checked for restriction and compression can be roughly checked by barring the engine over and at the same time observe valve and injector action for any indication of malfunctioning. These factors appear to be satisfactory, so the conclusion is that the fuel system is responsible.

The Cummins fuel pump consists of a No. 1 gear pump that transfers fuel from the supply tank to a float chamber situated on the fuel pump, a No. 2 gear pump that takes fuel from the float chamber and delivers it, through a distributor disc and cover assembly, to the metering pump. The metering pump measures the proper quantity of fuel and delivers it through the distributor disc and cover assembly to the proper injector at the proper time.

In order quickly to verify our conclusion that the difficulty is in the fuel system, we can disconnect the fuel line at the injector inlet connection and, with throttle in maximum fuel position, turn the engine over with the starter. If no fuel is ejected from the fuel line, our conclusion was correct. It is then logical to start at the beginning:

1. If the No. 1 gear pump is working properly, the float chamber will be full to the normal level.
2. If the No. 2 gear pump is working properly, fuel will flow from the disconnected fuel supply line when the priming valve is opened and the engine turned over with the starter.
3. As trouble has not shown up in preceding checks, it will be found in the distributor disc and cover or the metering pump. It would be natural to remove the disc and cover assembly first and if this part is not scored, removal of the distributor assembly would follow. The mechanic could then determine the cause of the metering pump failing to function and make the necessary repairs.

This example of trouble shooting sounds easy and when the natural sequence of functions is followed, it is easy. Engines have been disassembled in the search for the cause of this type of failure. Why was this done? It was the result of not analyzing the failure, or in plain language, failure to think before acting.

It might be said that this is an extremely easy example and for that reason, it appeared to be a very simple matter to analyze the problem or "shoot trouble." Actually, it is just as simple on other types of problems as it is on this one, the only difference being that you have a different set of component parts and a different sequence to follow.

Many may have experienced excessive oil consumption on engines in the past. You probably have heard maintenance people discussing the problem and realize there are many different opinions on the cause of oil consumption. How many times have you heard anyone definitely tie down the location of the trouble and then attempt to analyze the problem to determine the cause?

The terminology "oil consumption" is used whenever, in the opinion of the operator, an engine requires an excessive quantity of make-up lube oil. Sometimes the cause of the complaint is right here. The very first step is to make a thorough check of the amount of lube oil added over a specified period of operation. Let's assume this is done and the engine is using an excessive amount of oil. The first question is: Where is the oil going? Again the individual making the investigation must know the principles of operation in general and the construction of the engine in detail.

The first and easiest check to make is for external leaks. This should be thorough and of course will require cleaning of the engine and then observing it after operation. No major leaks are found so we must look elsewhere. As excessive make-up oil is required and it is not showing up as a leak, it must be getting into the combustion chamber and is being burned. Knowing the construction of the engine, we know it can get into the combustion chamber by several routes.

1. Entering fuel returned from injectors if seals are leaking and then later being injected, with the fuel, into the cylinders.
2. Entering the fuel through leakage by the seal between the governor and the fuel pump housings on some model pumps.
3. Entering the combustion chamber by passing down the intake valve guide.
4. Entering the exhaust manifold by passing down the exhaust valve guide and then going out the exhaust system with the gases.
5. Entering the combustion chamber due to leakage by piston rings.
6. On supercharged engines, oil can

†Substance of talk delivered at Marietta, Pennsylvania, July 1951.

*General Service Manager, Cummins Engine Company, Inc.

enter the air induction system if leakage occurs at the supercharger seals and will be carried into combustion chamber.

7. If the engine has the crankcase ventilated and the scavenging is accomplished by a passage connected to the engine air induction system, oil can be pulled over into intake air stream if provisions are not provided to prevent this from occurring.

8. Oil loss through air compressor or other similar auxiliary equipment that is lubricated by the engine lube oil system.

Any individual who is sufficiently acquainted with an engine to perform maintenance operations knows these facts and if he will stop and think he can outline a course for his investigation that will require the least amount of time and effort and yet check each item. A brief outline of the investigation follows:

1. Examination of fuel in float chamber of fuel pump will reveal if leakage is at injector seals or governor and fuel pump housing seal.
2. Examination of air receiver will determine if loss of oil is occurring through compressor. Examination of any other similar auxiliary equipment will also be necessary.
3. Removal of intake manifold will allow inspection to determine if oil is coming from (a) intake valve guides, (b) supercharger or (c) crankcase scavenging line. If evidence is found at this location, an examination of each of the three possible sources will determine which is responsible.
4. Removal of exhaust manifold will permit inspection for evidence of oil coming down exhaust valve guides.
5. The next step would be removal of pistons for examination of rings, combustion chamber, and cylinder head. This is the last operation as it involves the most work and a good portion of preceding work is leading up to this operation anyway.

This method of analyzing the problem and sequence of the investigation is similar to that used in locating trouble in the fuel pump. Many of you may know of instances where an engine has been completely disassembled because of oil consumption complaint and then the cause could not be found because the evidence was destroyed during the disassembling. In these instances, the mechanic is sure that "gremlins" have been drinking the oil but to be sure, he rebuilds the engine with all new parts. This is expensive as well as costly in down time.

In conclusion, "Trouble Shooting" is nothing more or less than an organized study of the problem and a planned method of procedure for the investigation and correction of the difficulty. There is nothing mysterious or complicated about it—it's just plain organized thinking.

* * *

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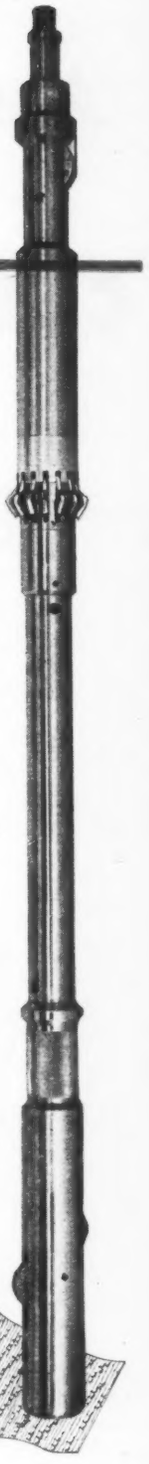

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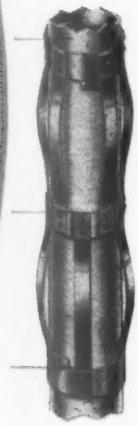

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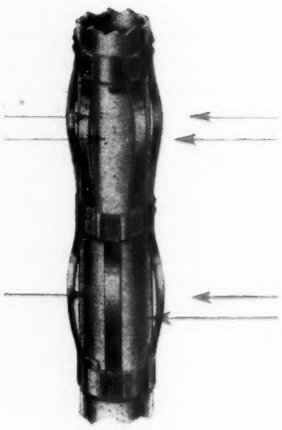

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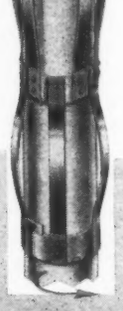

3. Casing may be freely rotated within centralizer without binding or sticking.

4. Installed simply by welding positioning lugs to casing.

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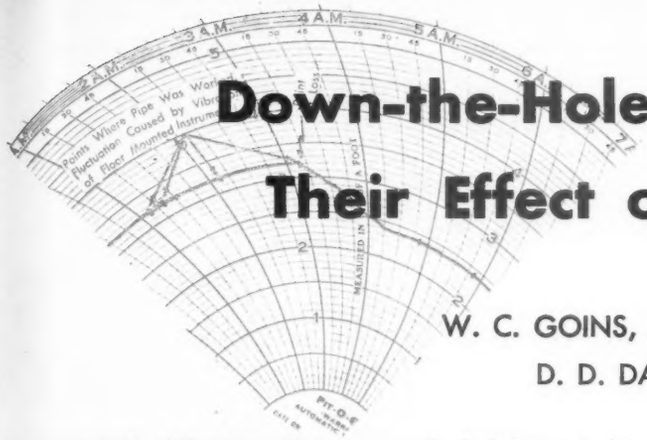


Down-the-Hole Pressure Surges and Their Effect on Loss of Circulation†

W. C. GOINS, JR.,* J. P. WEICHERT,* J. L. BURBA, JR.*
D. D. DAWSON, JR.,* and A. J. TEPLITZ‡

Measurements of Pressure Surges

Because of some particularly troublesome lost circulation difficulties in a number of wells drilled in 1948, Gulf Oil Corporation assigned a group of engineers to the general study of the problem. The S. S. Perry No. 1 well at Peach Point had 45 separate losses of circulation, and it was decided that future operations in this area would be closely studied by the group.

Observations made during the course of drilling the S. S. Perry No. 2 well in this field revealed that there were 22 instances of loss of circulation; and that of these, 3 were associated with balling of the drill collars, 6 with downward movements of balled collars, 5 with downward pipe movements alone, and 8 could not be associated with any apparent cause.

The methods through which this information was developed were as follows:

The pipe was usually pulled from the hole after each loss, and balling was observed at the surface. Otherwise balling was detected from the drag occurring during pipe withdrawal to the casing or through the use of a pump-stroke recorder, which showed a slowing of the mud pump as the ball formed. Also, it was observed that development of balling coincided with pronounced increases in viscosity of the silicate mud used.

Pipe movements were shown to be an immediate cause of loss of circulation through the use of a pit-level recorder that was mounted on the rig floor. Although the purpose of this instrument was the detection of changes in mud volume, it was observed that vibration of the drawworks during working of the pipe shook the recording pen of the instrument so that each sharp movement could be identified. In the instances where working the pipe was associated with losses, charts similar to that of Fig. 1 were found where the pit level decreased immediately after a pipe movement.

Another noteworthy observation was that in this field the hole almost invariably remained full after a loss of circulation, indicating that the formations in the area were capable of supporting the required hydrostatic pressures. This was true even though mud densities as high as 17.5 ppg had been used. This led to the conclusion that pressures in excess of necessary hydrostatic pressure, caused by balling and pipe movements, were breaking down the formation after which the circulating pressures were sufficient to cause the formation to take mud. It was believed that if the pressures could be kept near the required hydrostatic pressure, then losses could be prevented.

It was evident that balling would substantially raise the pressure below the point of the ball and working of balled pipe would be expected to magnify this effect. If balling could be eliminated, high pressures from this source would be avoided.

Circulating pressures below the bit could be approximated and were known to be of a low order. No information was available as to the magnitude of pressure surges due to pipe movement, and a decision was made to investigate these to see if they were great enough to be responsible for breaking the formation down.

Measurement of Pressure Surges

A sub was made to replace the bit in a drilling string and two pressure recorders were attached. The sub shown in Fig. 2 contained two 5/8-in. ports through which circulation could be established, and the pressure recorders were either 7500 psi or 15,000 psi drillstem test recorders furnished through the courtesy of Johnston Oil Well Testing Company. These were selected because of their rugged construction and their ability to measure high pressures.

Using this equipment, tests were run inside casing in a number of wells to determine the effects of running and withdrawing pipe, spudding while pumping, and rapid opening of

†Presented at the Spring Meeting, Southwestern District, API Division of Production, Beaumont, Texas, March 7-8-9, 1951.

*Gulf Oil Corporation, Houston, Texas.
‡Gulf Research and Development Company, Pittsburgh, Pennsylvania.

TABLE 1. Table of mud properties and pipe-casing combinations for wells in which tests were made.

Test No.	Type of mud used	Density (ppg)	Funnel viscosity (sec)	Stormer viscosity (sec)	Thixotrophy (grams) Initial	Thixotrophy (grams) 10 min	Casing size (in.)	O.D. rubber protectors (in.)	Annular area (sq.in.)	O.D. drill collars (in.)	Annular area (sq.in.)	Type tool joint	O.D. tool joint (in.)	Annular area (sq.in.)	O.D. drill pipe (in.)	Annular area (sq.in.)	Maximum Recording Pressure of gage used (psi)
1	Caustic and quebracho thinned, fresh water mud	10.1	44	—	Slightly cement cut		7	4½	14.3	4½	14.3		3⅞	18.5	2⅞	23.8	15,000
2	Same	11.8	46	52	0	1	7⅝	4⅞	18.5	4½	21.2		4½	21.1	3½	27.4	7,500
3	Lime treated mud	16.2	82	63	4	7	7	None used	—	4	17.6		3⅞	18.5	3½	20.3	15,000
4	Sodium silicate mud	14.0	49	—	2	8	9⅝	6⅝	27.1	6¼	30.9		5⅞	36.8	4½	46.2	7,500
5	Lime treated	11.8	43	27	0	0	9⅝	6¾	25.8	6¼	30.9		6	33.3	4½	46.2	15,000

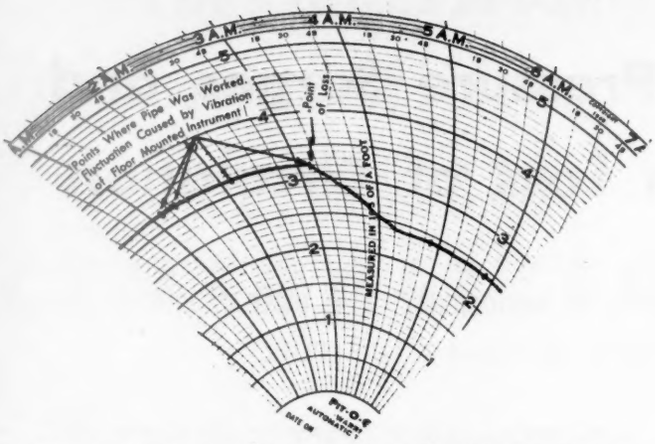
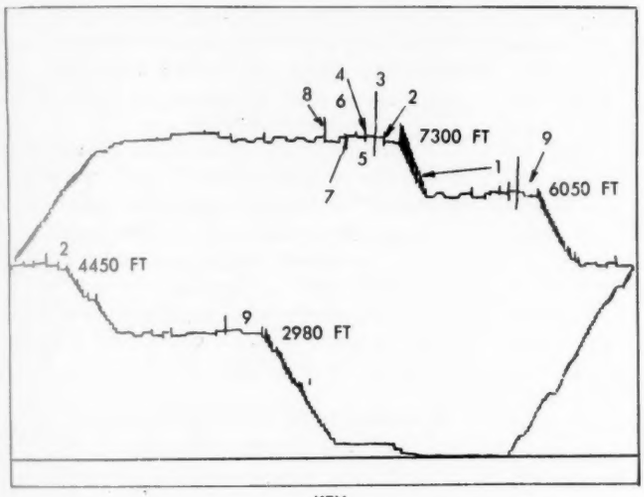


FIG. 1. Chart from Warren Automatic Tool Company—"Pit-O-Graph".



KEY

(1) RUNNING PIPE (2) RAPIDLY BREAKING CIRCULATION
(3) RAPIDLY SPUDDING 35 FT OF PIPE WHILE CIRCULATING
(4) RAPIDLY WITHDRAWING 35 FT OF PIPE WHILE CIRCULATING
(5) SLOWLY SPUDDING WITH 35 FT OF PIPE WHILE CIRCULATING
(6) SLOWLY WITHDRAWING 35 FT OF PIPE WHILE CIRCULATING
(7) CIRCULATION STOPPED
(8) RAPIDLY RUNNING ONE 90 FT STAND
(9) CIRCULATION STARTED SLOWLY

FIG. 3. Pressure recorder chart from Test 4. Recorder: Johnston Oil Well Service Company. 7500 psi maximum drillstem test pressure recorder.

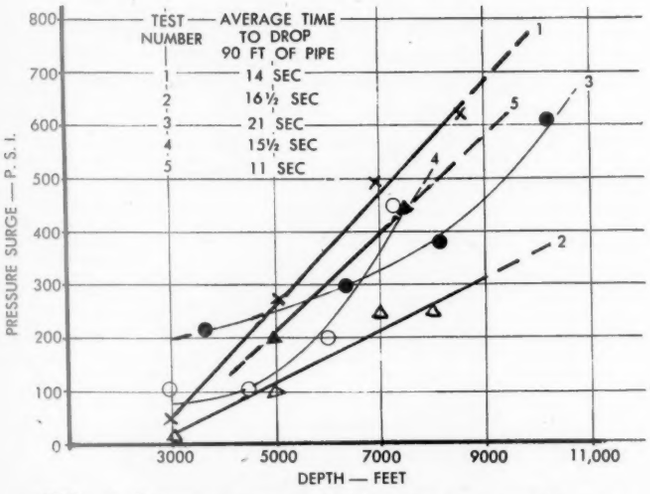


FIG. 4. Pressure surges due to running rapidly one stand of drill pipe.

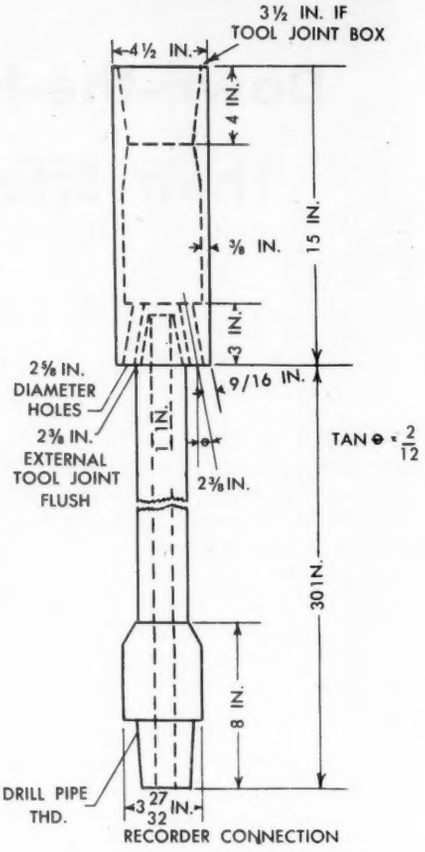


FIG. 2. Pressure recorder sub.

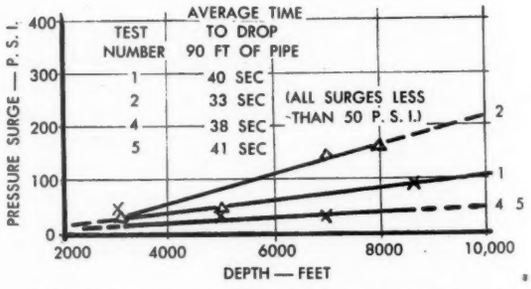

TEST NUMBER
AVERAGE TIME TO DROP 90 FT OF PIPE
1 40 SEC
2 33 SEC
4 38 SEC
5 41 SEC
(ALL SURGES LESS THAN 50 P. S. I.)
PRESSURE SURGE — P. S. I.
DEPTH — FEET

FIG. 5. Pressure surges due to running slowly one stand of drill pipe.

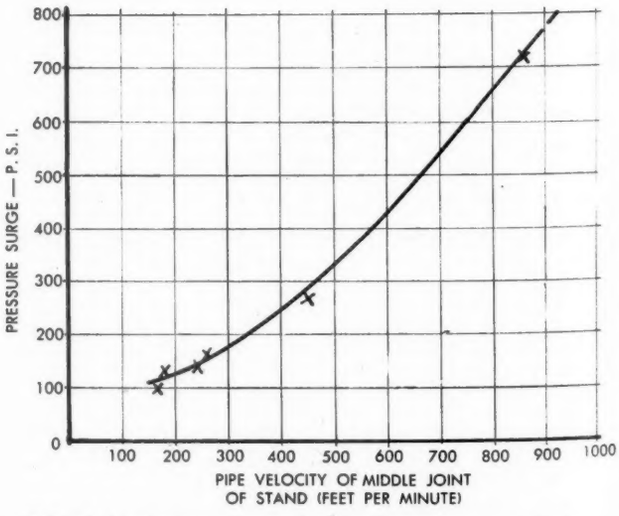


FIG. 6. Variation of surge pressure with rate of pipe movement when running one stand in Test 1 at 8000 ft.

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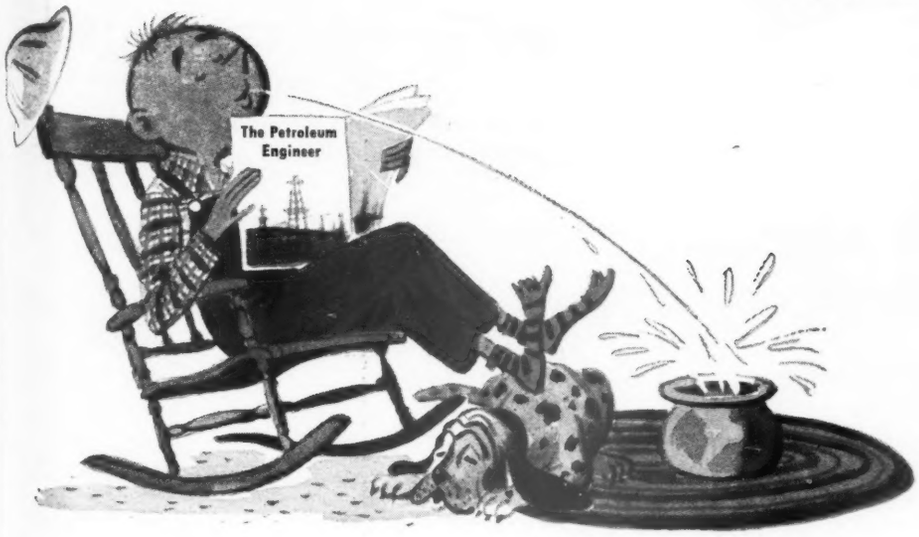
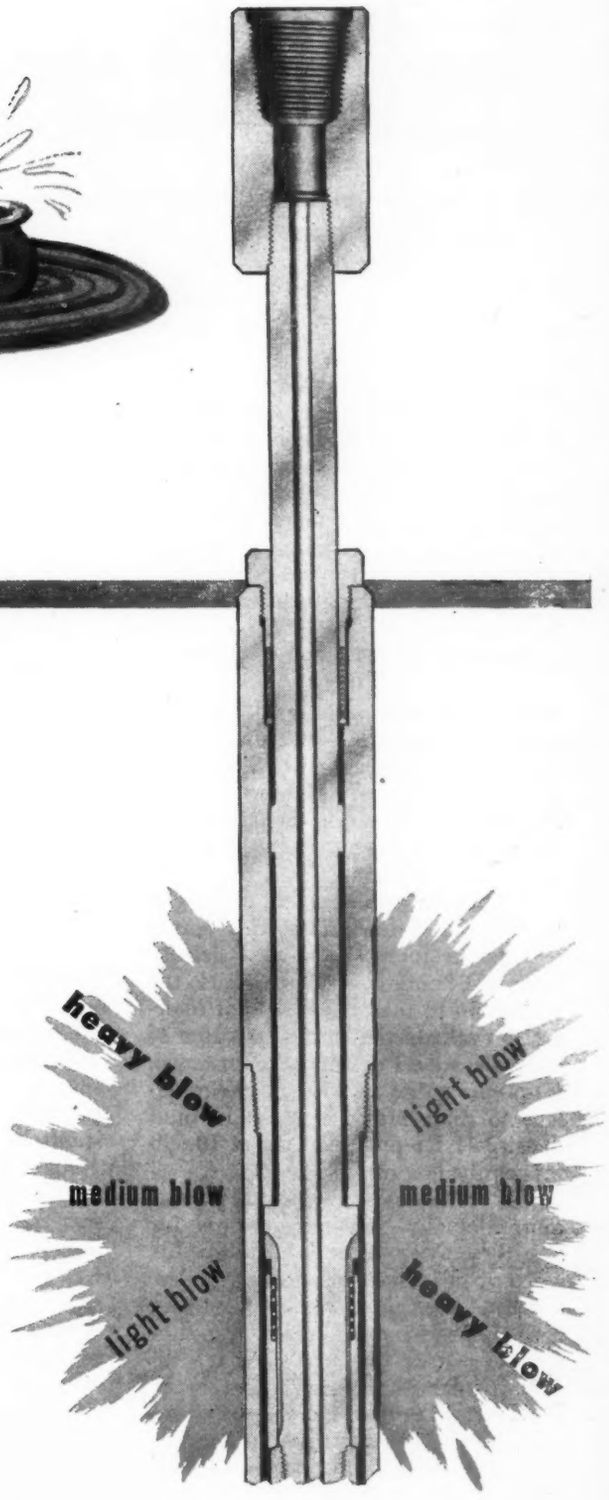


Jarring Jerry



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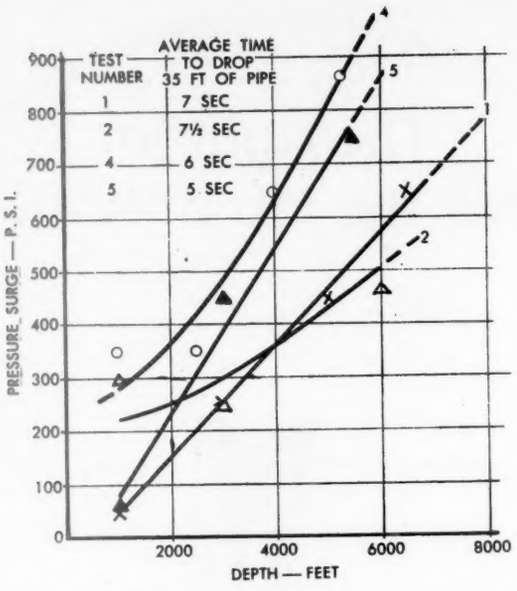


FIG. 7. Pressure surges due to rapidly spudding 35 ft of pipe while circulating.

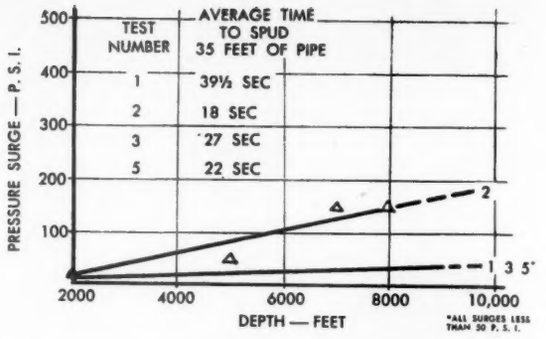


FIG. 8. Pressure surges due to spudding slowly 35 ft of pipe while circulating.

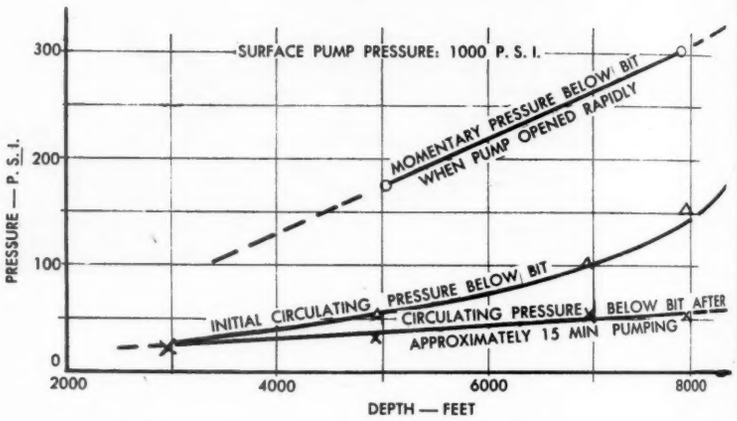

SURFACE PUMP PRESSURE: 1000 P. S. I.
MOMENTARY PRESSURE BELOW BIT WHEN PUMP OPENED RAPIDLY
INITIAL CIRCULATING PRESSURE BELOW BIT
CIRCULATING PRESSURE BELOW BIT AFTER APPROXIMATELY 15 MIN PUMPING
PRESSURE — P. S. I.
DEPTH — FEET

FIG. 9. Circulating pressure as measured below the bit in Test 2. Surface pump pressure: 1100 psi.

pumps to start circulation. A typical pressure recorder chart from the tests is shown in Fig. 3. Table 1 lists the mud properties and casing-drilling string combinations of the wells in which the tests were made. The work in each well was given a test number that is used to letter the corresponding curves in the figures which follow.

Pressure Surges Due to Running Pipe

Fig. 4 shows the surges due to running pipe at normal rates in 5 wells. The time required to drop 90 ft of stand in each test is shown on the graph. Pressure surges as high as 600 psi at 8500 ft were found; the surges increased with depth.

A common experience in drilling is to find that a few tenths of a pound per gallon increase in mud density over that being carried will cause the formation to take fluid. It is of interest to evaluate the surges in terms of equivalent mud density. For instance, a 450-psi surge at 7500 ft is equivalent to momentary increase in mud density of 1.1 ppg; 650 psi at 10,000 ft is equivalent to 1.2 ppg.

The results of dropping the pipe at approximately one-half normal or slightly slower rates are shown for some of the same wells in Fig. 5. The time for dropping one stand ranged from 37 to 44 sec. and resulted in substantial decreases in the surges. With only one exception (test 2) the surges were 100 psi or less at all depths where determinations were made.

Fig. 6 shows the effect of varying rates of pipe movement on the surges at 8000 ft in Test 1. In this instance a Gulf Research and Development Company pressure recorder was mounted inside the drill collar. The rate of pipe movement was calculated from the time for the middle joint of a 90-ft stand to drop through the rotary table; and is, therefore, approximately the maximum velocity of the pipe. These results show that the magnitude of the surges (which were lower because of pressure drop through the bit) is dependent upon the rate of pipe movement.

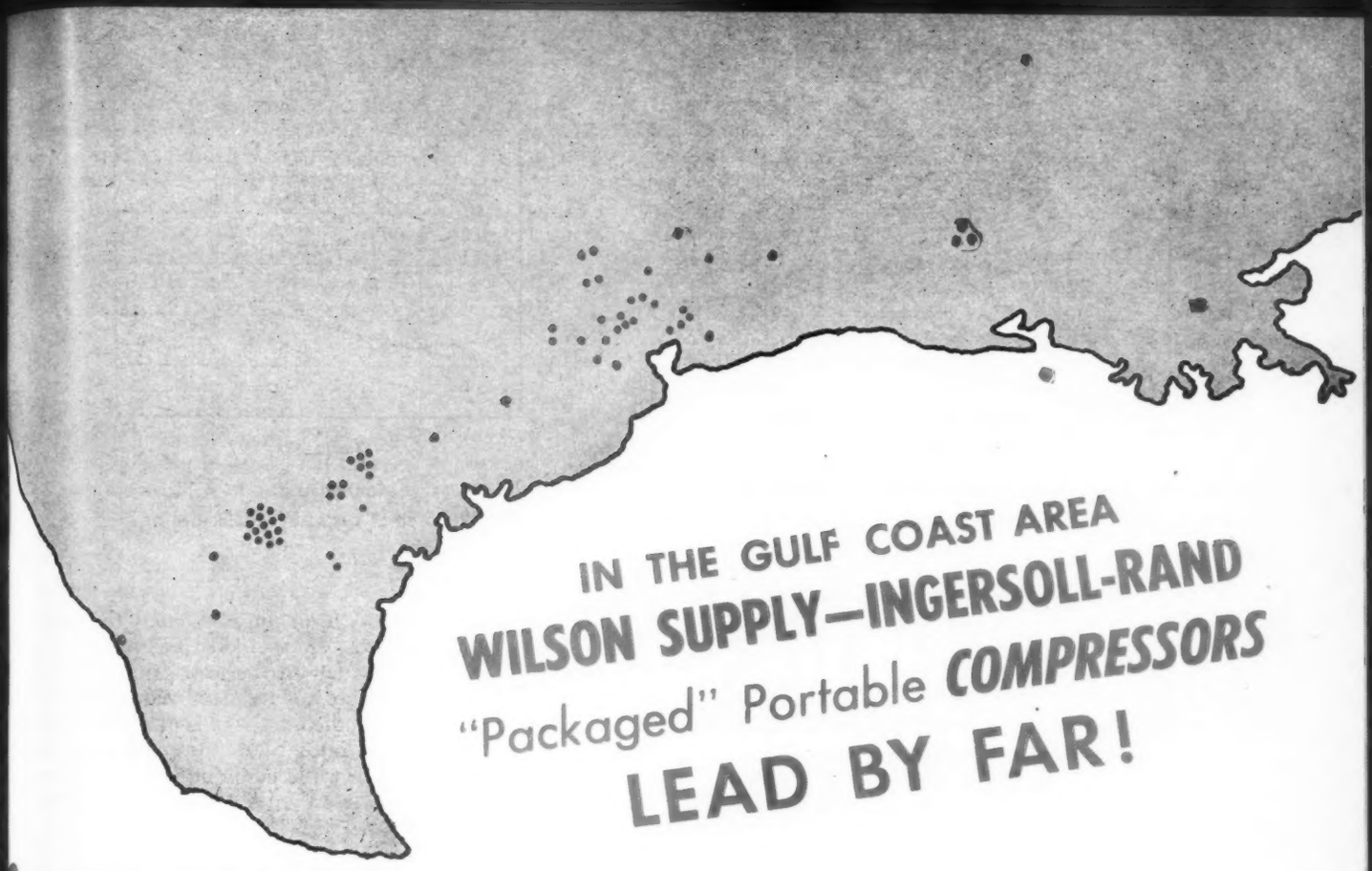
Measurements were also made in several instances of the surges when plugged stands were run. This substantially increased the surges previously found. As an illustration, in test 2 (Fig. 4) the surge at 8000 ft was 250 psi when the stand was run in 16½ sec. When a plugged string was run at this depth and rate the surge was 415 psi. In test 1 the surge at 8500 ft was 650 psi when the stand was run in 14 sec. With a plugged stand the surge was 800 psi. These two plugged-stand surges were equivalent to momentary increases in mud density of 1.0 and 1.8 ppg, respectively.

Surges Due to Rapidly Spudding While Pumping

Tests were also made of the effect of spudding with 35 ft of kelley while pumping was in progress. These results are shown graphically in Fig. 7. The time to drop the 35 ft of pipe varied for the different tests from 5 to 7½ sec. In general, the surges were greater than for running pipe. The surges of 750 psi at 7500 ft in test 5 is equivalent to a momentary increase in mud density of 1.9 ppg. For test 3 at 7300 ft the surge of 860 psi is equivalent to 2.3 ppg of mud density. Spudding at slow rates resulted in substantially lower surges, as shown in Fig. 8.

Surges Due to Rapidly Opening Pumps to Start Circulation

It was suspected that a surge pressure would result when pumps were started rapidly to break circulation. This was followed in test 2 and the results are shown in Fig. 9. At 8000 ft, when the pump was opened rapidly a momentary pressure of 300 psi below the bit sub was obtained. This decreased to 150 psi as soon as circulation was established. After approxi-



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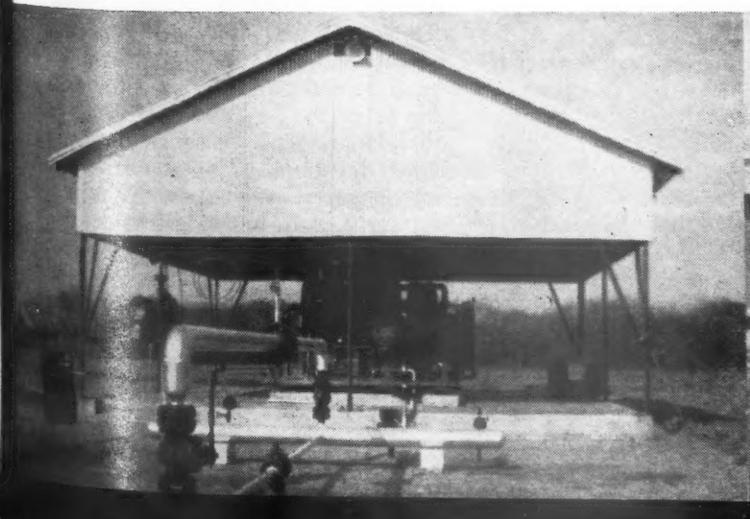

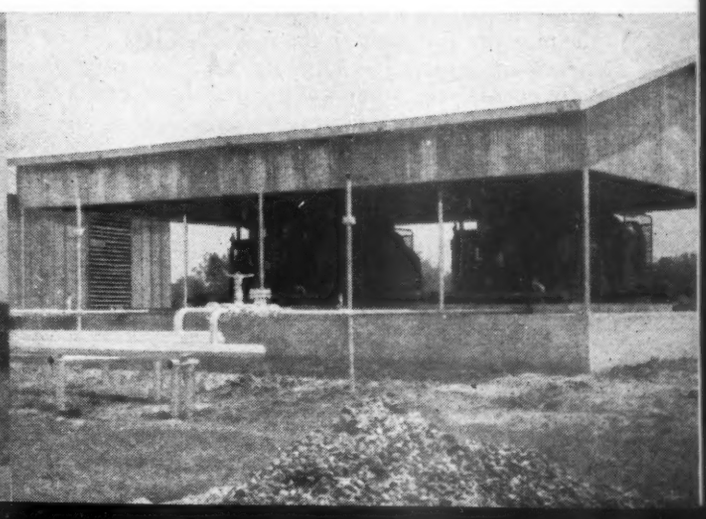

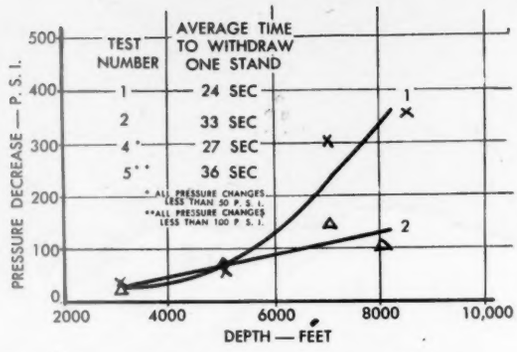
AVERAGE TIME TO WITHDRAW ONE STAND
TEST NUMBER
1 — 24 SEC
2 — 33 SEC
4* — 27 SEC
5** — 36 SEC
* ALL PRESSURE CHANGES LESS THAN 50 P. S. I.
** ALL PRESSURE CHANGES LESS THAN 100 P. S. I.
PRESSURE DECREASE — P. S. I.
DEPTH — FEET

FIG. 10. Pressure decrease due to withdrawing rapidly one stand.

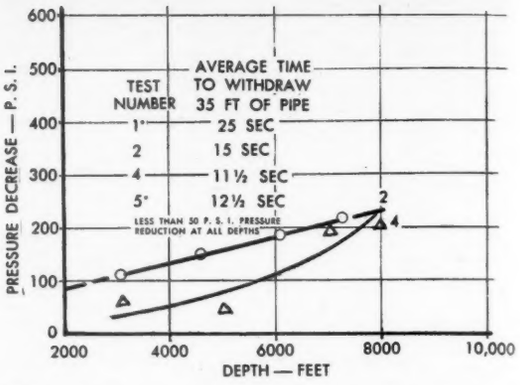
AVERAGE TIME TO WITHDRAW 35 FT OF PIPE
TEST NUMBER
1* — 25 SEC
2 — 15 SEC
4 — 11½ SEC
5* — 12½ SEC
LESS THAN 50 P. S. I. PRESSURE REDUCTION AT ALL DEPTHS
PRESSURE DECREASE — P. S. I.
DEPTH — FEET

FIG. 11. Pressure decrease due to withdrawing rapidly 35 ft of pipe while circulating.

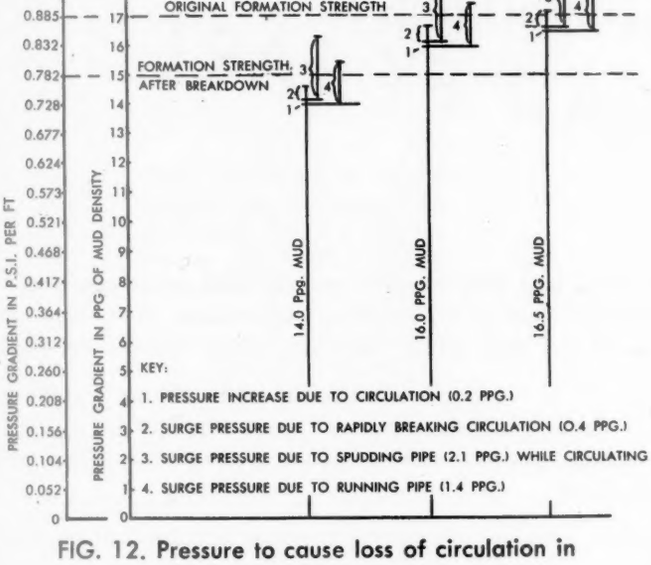
ORIGINAL FORMATION STRENGTH
FORMATION STRENGTH AFTER BREAKDOWN
14.0 Ppg. MUD
16.0 PPG. MUD
16.5 PPG. MUD
PRESSURE GRADIENT IN P.S.I. PER FT
PRESSURE GRADIENT IN PPG OF MUD DENSITY
KEY:
1. PRESSURE INCREASE DUE TO CIRCULATION (0.2 PPG.)
2. SURGE PRESSURE DUE TO RAPIDLY BREAKING CIRCULATION (0.4 PPG.)
3. SURGE PRESSURE DUE TO SPUDDING PIPE (2.1 PPG.) WHILE CIRCULATING
4. SURGE PRESSURE DUE TO RUNNING PIPE (1.4 PPG.)

FIG. 12. Pressure to cause loss of circulation in a theoretical well.

mately 15 minutes pumping the circulating pressure had reduced to 50 psi. This latter decrease in circulating pressure was evidently due to a decrease in apparent viscosity as the gels were broken out of the mud. The first surge was probably due to the force required to accelerate the long mud column from zero to the sustained circulating rate and to break down the initial gel of the mud.

When the pumps were started slowly the pressure rose only to the initial circulating pressure. The surge due to rapidly opening the pump was greater than the initial circulating pressure by 150 psi, or an equivalent momentary increase in mud density of 0.36 ppg.

Swabbing Effects

Cannon[1] has shown the pressure reduction obtained during pipe withdrawal. He found that the amount of the reduction was largely dependent upon the gel strength of the mud, the length of the pipe, and the annular clearances. In the tests reported here the mud did not have high gel strengths. Consequently the swabbing effects were of a low order. Fig. 10 shows the results obtained when stands were pulled at normal rates. Test 1, in which the mud was slightly cement cut and gelled, gave a pressure reduction of 350 psi at 8500 ft. The results from other tests were generally 100 psi or less at all depths. Withdrawing one stand in 60 to 80 seconds in Test 1 gave the surges less than 50 psi at all depths. In the other tests, withdrawing pipe at 50 to 60 seconds per stand also gave pressure reductions of less than 50 psi.

It was surprising to find that pressure reductions generally occurred when the pipe was withdrawn while pumping was in progress. Fig. 11 shows the results of rapidly withdrawing 35 ft, or approximately the kelley length. These reductions were of a low order for the tests conducted, but were greater than the reductions due to withdrawing stands of pipe at maximum rates. Slow rates of withdrawal of pipe while pumping was in progress gave less than 50 psi pressure reductions.

Summary of Testing Results

As a result of the tests it was found that running pipe at normal rates and rapidly spudding during circulation gave pressure surges of a high order that increased with depth. Rapidly breaking circulation also gave large pressure surges. These pressure surges are great enough, when imposed on hydrostatic pressure, frequently to be an immediate cause of loss of circulation. The surges may be avoided through slowed rates of pipe movement and slow breaking of circulation. While the effect of annular clearances and mud properties on these surges was not clearly shown, the tests were conducted under a variety of conditions that indicated that the effects found should be expected in almost any well.

Specific Application of Results

The information developed was applied in the drilling of a recent well at Peach Point, the J. F. Perry et al Unit No. 1. Every effort was made to keep to a minimum the pressures above required hydrostatic pressure. Three and one-half in. drill pipe with Hydril slim-hole tool joints without rubber protectors was used for drilling below the 7-in. casing, the interval that in previous wells had given the most difficulties. This increased the annular area over that with the pipe formerly used, and was expected to reduce annular circulating pressure. The viscosity and gels of the mud were kept as low as possible. Balling was eliminated through the use of a

controlled rate of drilling and emulsion muds containing 10 per cent diesel oil and sodium tall oil emulsifier. The pumps were opened slowly when circulation was begun, and a controlled rate of pipe movement was initiated. This involved running pipe in the hole at a rate so that from 35 to 40 seconds were required to drop one stand of pipe. As a normal rate is from 14 to 15 seconds, this added less than 1 hour to trip time, even as deep as 10,000 ft. Precautions were taken to keep pipe movements to a very slow rate while pumping was in progress. It was believed that these measures would keep the pressure surges in the well to 100 psi or less.

The success of the overall program to keep pressures down was evidenced by the fact that this well was drilled to total depth without loss of circulation, even though there had been a total of 79 losses while drilling the 3 previous wells in this field.

General Application of Test Results

The information on the Peach Point operations has been presented because it shows the circumstances that led to making the tests and is a convincing demonstration of the applicability of the data developed. It is not intended to imply that lost circulation may always be prevented through the methods of keeping pressures in excess of required hydrostatic pressure to a minimum. In some wells exposed formations will not support the necessary hydrostatic pressure. It is reasoned, however, that high surge pressures would complicate attempts to seal formations and might repeatedly break them down, even after they had been sealed sufficiently to support the required hydrostatic pressure.

Fig. 12 has been prepared to illustrate the manner in which it is believed that loss of circulation often occurs in abnormal pressure drilling in the Gulf Coast area. It is set up for a theoretical hole that would support a mud of 17-ppg density, or a pressure gradient of 0.885 psi per foot without breaking down. This figure approaches the maximum pressure that most holes will withstand. If a 16.0-ppg mud is used, circulation would add a down-the-hole pressure equivalent to about 0.2-ppg mud density increase, and no loss of circulation should occur. If the pipe is spudded rapidly or run in the hole at the usual rates, pressure surges equivalent to about 2.1 or 1.4 ppg of mud density, respectively, may result. Either of these, added to hydrostatic and circulating pressures, would exceed the strength of the formation and cause it to take mud.

It is generally recognized from squeeze cementing, acidizing, and "Hydrofrac" operations that once a formation has been broken down it will take fluid more readily. Once this has occurred the formation may take fluid when circulation is established, or the fluid level may drop, depending upon the strength of the formation after breakdown. It is not implied that in loss of circulation in abnormal pressure wells the formations are always fractured by the pressures in the hole, for it may be true that existing fractures are opened by the pressure.

If a mud of 14.0-ppg density is circulated under the conditions illustrated then none of the surge pressures would be great enough to break down the formation. If a 16.5-ppg mud is circulated, then opening the pump rapidly would give a surge great enough to break down the formation.

The illustration given is chiefly relative to abnormal pressure drilling where high hydrostatic pressures are required. It is believed, however, that the surge pressures will also have an effect on loss of circulation in normal pressure gradient drilling. As the hydrostatic pressures are not great when this type of loss occurs, it is believed that the formations are not fractured

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by the well pressures. These losses appear to be due to the drilling of highly porous or cavernous zones through which mud can readily flow. Plugging these zones is difficult, and it has often been found that after plugging is accomplished increasing the mud density slightly will again break the formation down. In such instances it is evident that the plugged hole will support only low pressures. If the surge pressures are added to hydrostatic pressure, values in excess of that which the hole will support may result.

In the drilling of the limestone and dolmite of the Permian Basin losses have frequently been found to occur immediately following a round trip with the bit. This would indicate that surge pressures due to rapidly running pipe may have caused the loss.

Attention should also be given to surge pressures when rapidly running casing. Annular clearances are usually less with casing than with the drilling strings. These surges were not measured but must be of a high order and their effect is causing a loss may easily be imagined.

In summary, whenever the hydrostatic pressure in a well approaches the maximum that the formation will withstand, surge pressures due to pipe movement and rapidly starting pumps may cause a loss of circulation. It is believed that they should be avoided in drilling when a loss of circulation occurs or is considered likely. The data developed show that this may be done through slowed rates of pipe movement and slow starting of circulation.

Future Work Required

The information presented herein has only touched upon a subject that needs to be fully developed. Cannon[1] has shown the effect of annular area, gel strengths, and rate of pipe withdrawal on swabbing pressures. Chaney[2] discussed the possibility that "peak pressures caused by a balled bit, rapid lowering of the drill pipe, or by sharp pulsations in pump pressure" may increase pressures above formation strength in abnormal pressure wells. Otherwise, there seems to have been little consideration given to this matter. The effect of both the annular clearance and changes in mud properties on the pressure surges due to pipe movement needs to be clearly shown. It is hoped that this paper will encourage further work in this field.

Oil Taxes Soar

The three federal oil taxes paid in 10 per cent more in 1950 than they brought in in 1949, the Internal Revenue Bureau has reported. Total amount was $665,072,792 in 1950, topping 1949's $603,145,384. Collections included $551,449,723 from gasoline compared with $504,064,429 in 1949; $91,747,997 from lubricating oils against $80,317,326; the preceding year; and $21,875,071 from pipe line transportation levies compared with 1949's $18,764,629. Pipe line levies totaled more than $20,000,000 in 1950 for the first time.

Acknowledgment

The authors wish to express their appreciation to the management of Gulf Oil Corporation, Houston Production Division, and the Gulf Research and Development Company for permission to publish this paper.

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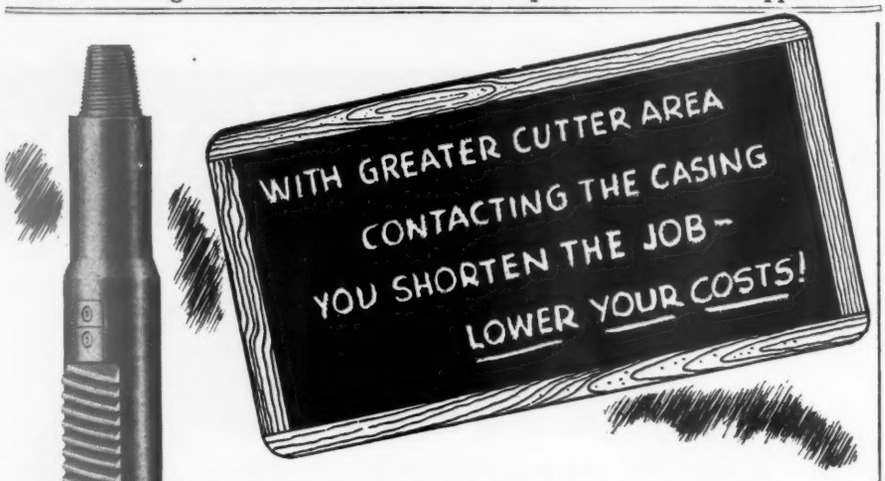
1. George E. Cannon: "Changes in Hydrostatic Pressure Due to Withdrawing Drill Pipe from the Hole," *Drilling and Production Practice*, 42-47, (1934).
2. P. E. Chaney: "Abnormal Pressures and Lost Circulation," *Drilling and Production Practice*, 145-152, (1949).

* * *



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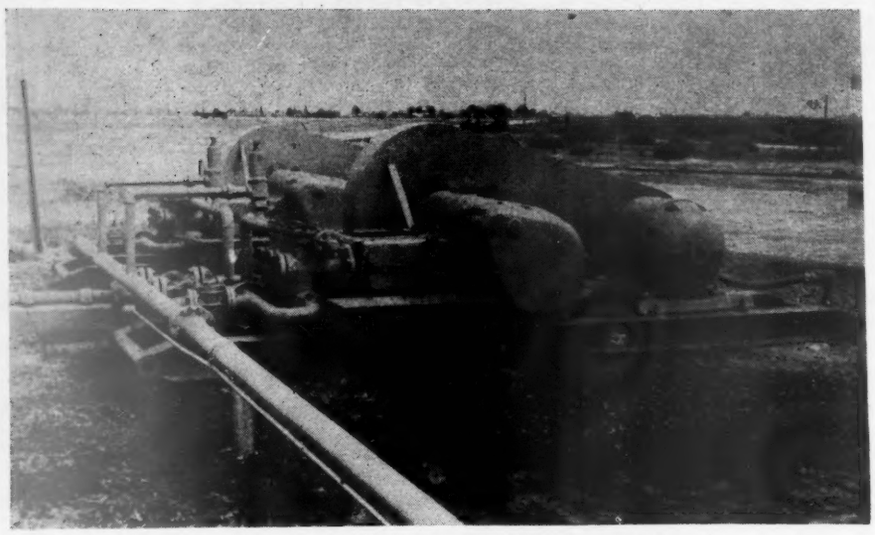


High pressure pumps handling oil field brines in Rio Bravo. Equipped with lube oil circulators for piston rods and packing glands.

Water Drained Automatically From Lube Oil Reservoir

Water separators built into supply tanks solve corrosive water disposal problem

J. C. ALBRIGHT

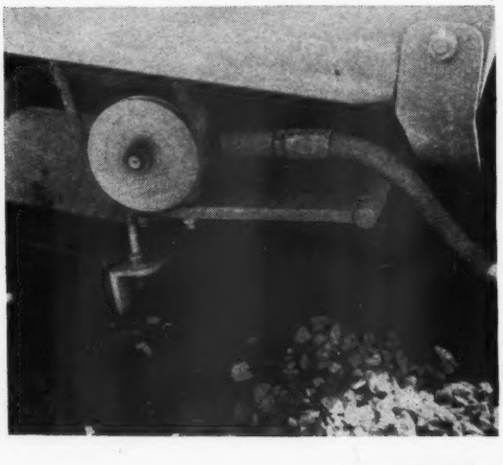
THE inherent disadvantage common to most lubricating systems designed in the field to supply a constant flow of oil to piston rods, plungers, and packing glands of pumps installed to transfer corrosive water, such as oil field brines, is that few are equipped with built-in provisions to separate water automatically from the lubricating oil reservoir. In such systems, the free water passing through the packing from the cylinders is supposed to separate from the oil and precipitate into the base of the supply tank for periodic draining. Frequently the operator neglects this vital operation, usually through no fault of his own but from pressing duties that require his attention elsewhere. Consequently, the oil either spills over the rim of the tanks, or the water will build up to the circulating pump suction and water will be transferred to the rods and other parts instead of the lubricating oil.

When the Rio Bravo oil field, in Kern County, California, was unitized and the major producer assumed operation, all semi-unattended pumps were equipped with a simplified rod lubricating system, which included a water separator built into the oil supply tank. The pumps illustrated are in service to dispose of oil field brines, and operate on discharge pressures up to 2000 psig. The separator systems have been designed to obtain the most effective separation of the water from the lubricating oil and to dispose of this waste without attention from the operators or pumpers.

The oil reservoir is a rectangular steel box, designed for the pump upon which it is to operate, with the dimensions selected to fit into a space where it will not interfere with the operation and maintenance of the unit. Material employed for the construction is conventional tank steel, heavy enough that the reservoir will maintain its original shape without being distorted by vibration and constant use. It contains a false bottom, approximately two inches above the floor, welded to the sides of the vessel, but supplied with a full width slot at one end for the water to flow freely into the compartment between the false bottom and the floor of the tank. A conductor for the water to pass from the reservoir is made of a convenient length of light-weight two inch angle iron, placed over a small opening in the opposite end of the false bottom from the full-width slot, and standing upright and welded water tight. The water outlet behind the angle iron conductor is located at a point calculated on hydrostatic head of fluids so that the weight of both oil and water will force the waste water from the reservoir while the top surface of the volume of lubricating oil is approximately two inches below the rim of the vessel. Waste from the reservoir is directed into a funnel, made by using a swedge nipple, through a half-inch nipple fitted with an ell and an all-thread nipple on the free end to provide final adjustment for siphoning and control of the water level in the reservoir.

The pump that circulates the lubricating oil over the piston rods is a small rotary unit attached to the frame of the water disposal pump on the side opposite the oil reservoir. It is mounted upon a flat bar of iron welded to a spring loaded rod, which in turn is attached to the side member of the pump foundation. The belt that drives this small oil pump takes power from the driven sheave to which the electric motor is connected to the large water

Small circulating belt-driven pump handles oil from supply tanks to piston rods of high pressure water pumps.



Swedge nipple as funnel in disposal system of waste water from packing glands that drains into oil supply tank and is siphoned away automatically.

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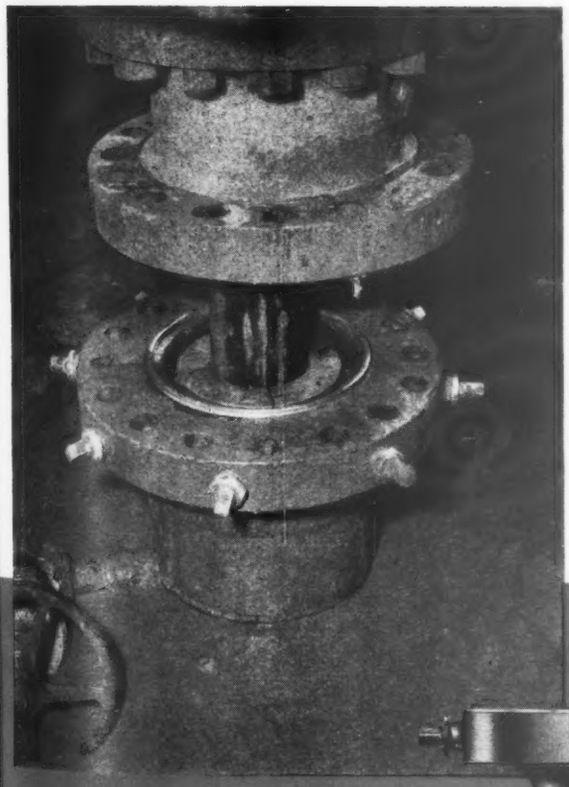

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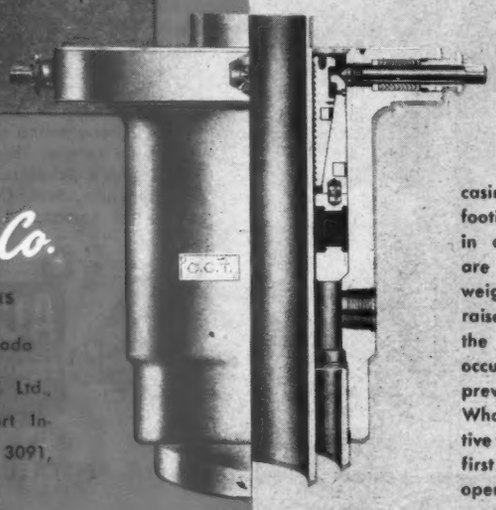

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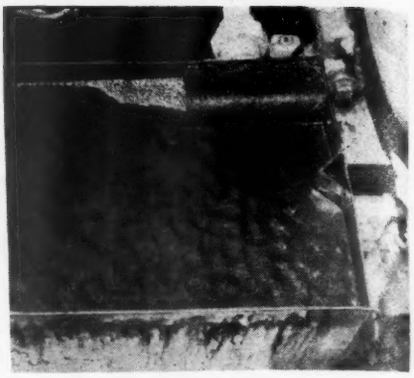
handling unit. The spring-loaded rod maintains the required tension on the circulating pump to provide constant delivery of oil to the pump rods and packing glands. Adjustment for wear and belt stretch is made with a threaded rod passed into an anchor strap welded to the web of the structural steel skid member of the pump foundation. Lock nuts are provided so that the tension will remain as required without being disturbed until the pumper makes another inspection. Suction from the reservoir and the discharge to the distributor piping above the piston rods are through armored hose, instead of stiff pipe connections, so that adjustment for belt tension can be made without breaking out lines or providing several full swing joints.

Oil return from the pump to the reservoir, after the lubricant has drained from the rods and packing glands, is through a one inch pipe connected to the side of the reservoir at approximately the desired fluid level. A baffle inside the reservoir and at the oil inlet prevents fluid from spreading over the surface of the fluid in the reservoir so that the water will precipitate readily into the false bottom chamber of the reservoir. The suction line attached to the circulating pump is connected to the side of the reservoir at a point well above the natural interface between the water and the oil. The interface between the oil and water is constant, so there is never any opportunity for the circulating pump to pick up water instead of oil. When the reservoir is cleaned and washed to remove sediment and spent oil, a fresh supply of water is added to bring the level high enough in the vessel so that automatic drainage will start at the predetermined level. So that foreign matter can be prevented from entering the reservoir full of fresh lubricant, a substantial steel cover is provided, having crimped edges that fit snugly around the rim, and is fitted so that a sharp pull is required for removal.

* * *



Surface of oil in circulating tank, showing deflector which contributes to precipitation of water from piston rods.

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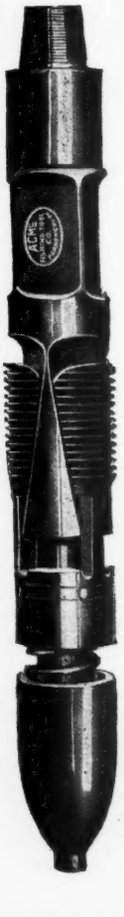

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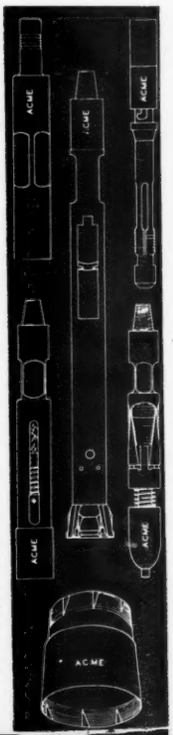

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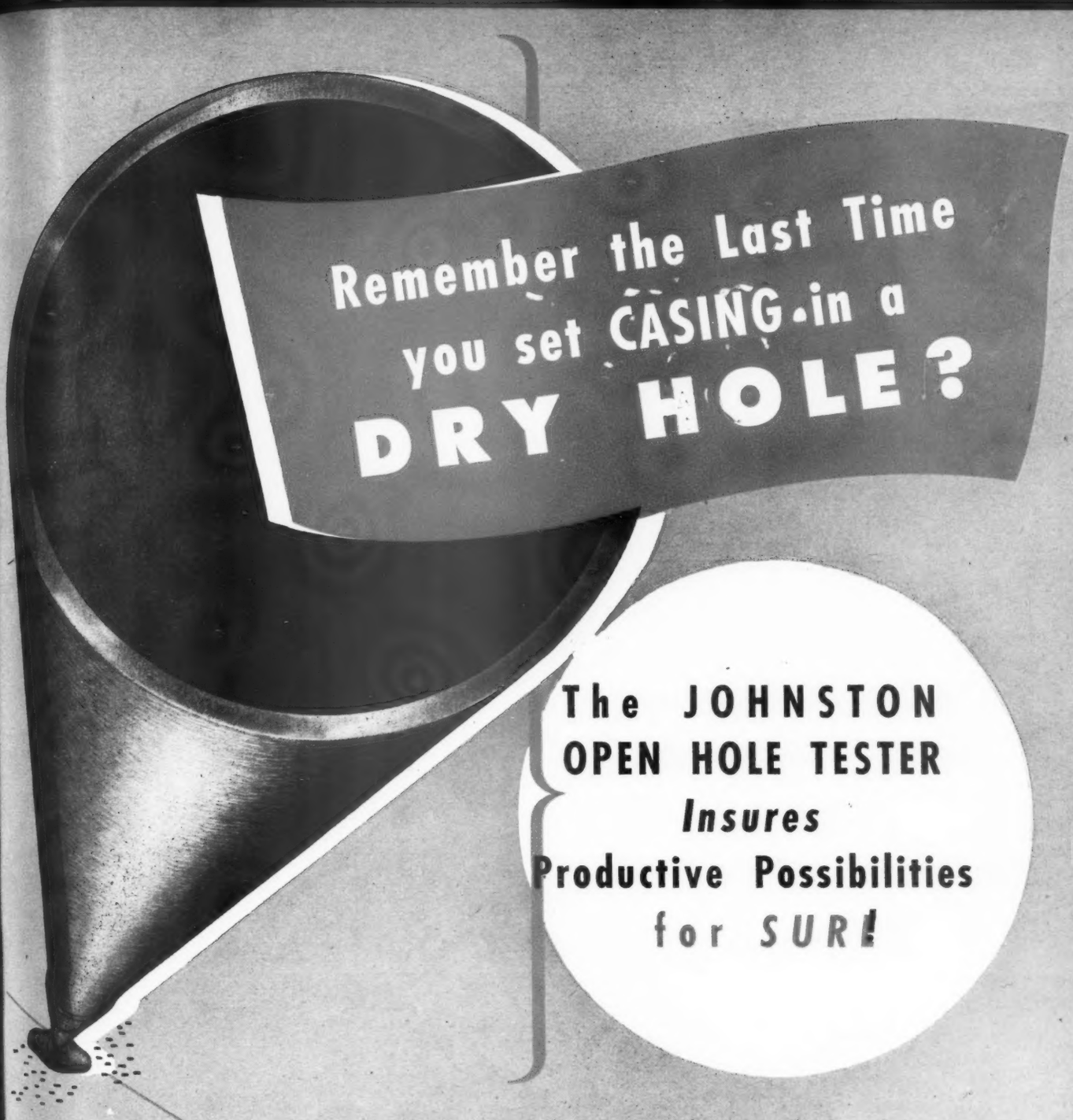

The JOHNSTON OPEN HOLE TESTER *Insures* Productive Possibilities for *SURE!*

Of course you remember that dry hole and that string of casing! But the thing to remember is the Johnston Open Hole Tester can **save that casing** for you if the productive possibilities are no good.

See that your efforts and resources go into a producer — not a dry hole. When it is time to test — call an experienced Johnston representative. They're in all active areas, ready to serve you 24 hours a day.

JOHNSTON OIL FIELD SERVICE CORP.
5702 NAVIGATION BOULEVARD HOUSTON, TEXAS

TEXAS—Houston, Beaumont, Alice, McAllen, Abilene, Cisco, Winters, Bowie, Gainesville, Graham, Jacksboro, Knox City, Throckmorton, Wichita Falls, Tyler, Victoria, Brownfield, Kermit, Midland, Odessa, San Angelo, Snyder. ARKANSAS—Magnolia. INDIANA—New Harmony. KANSAS—Great Bend, Liberal, Plainville, Pratt. KENTUCKY—Henderson. LOUISIANA—Lake Charles, Shreveport. MISSISSIPPI—Brookhaven. NEW MEXICO—Farmington, Hobbs. OKLAHOMA—Chickasha, Elk City, Healdton, Terry, Seminole.

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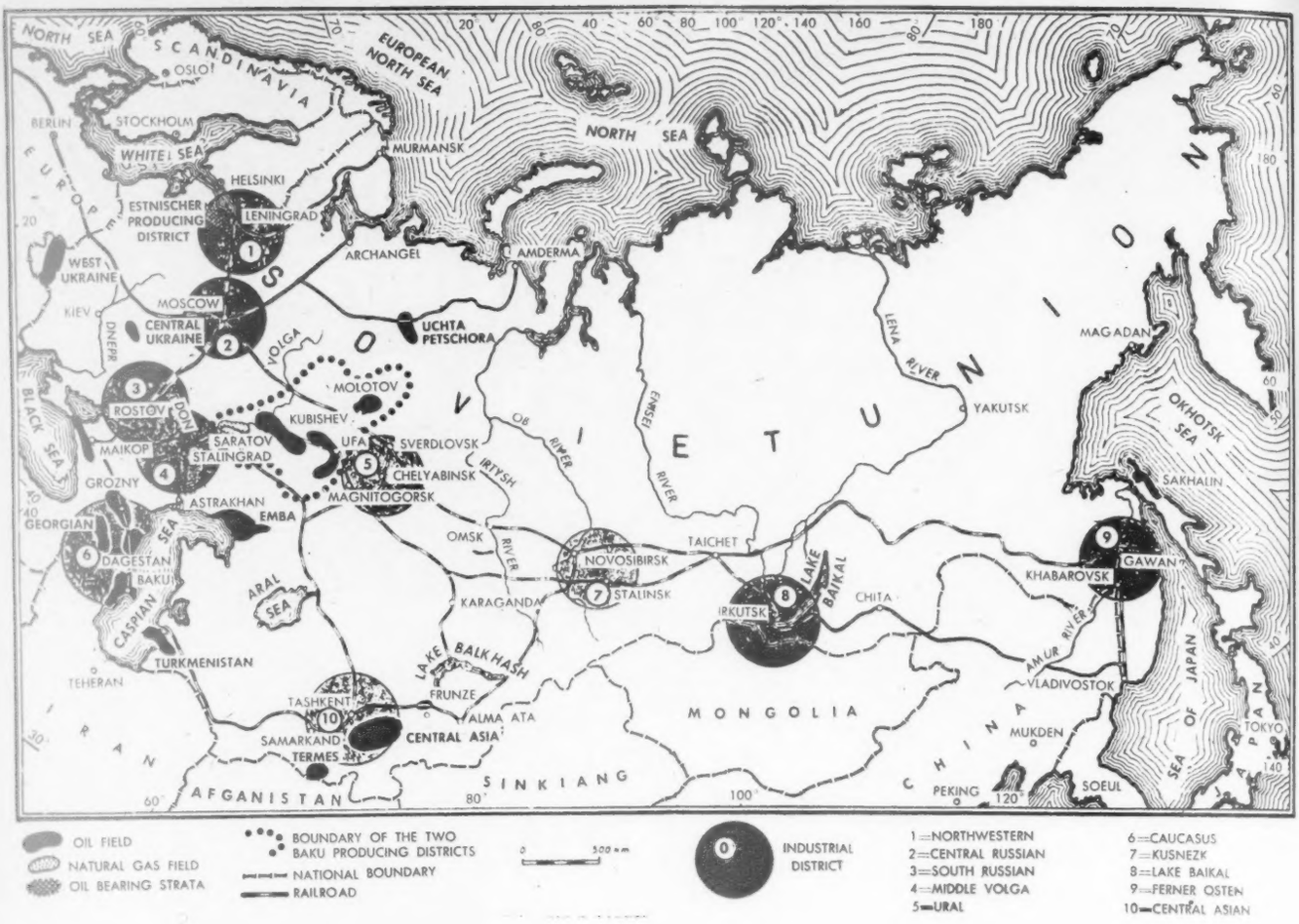


A Study of SOVIET Oil Industry†

REVIEWED BY ARCH L. FOSTER

ERDOL IN DER SWOJETUNION*, by Dr. Heinrich Hassman, is a condensed work in German, which appears to cover with satisfactory thoroughness within the space utilized the fundamentals of the Russian petroleum industry, presented in four parts. These parts are titled: (1) The general background (foundations) of the Russian petroleum industry (economy); (2) development of the Russian petroleum industry; (3) the Russian petroleum districts (producing); (4) the problems of the Russian petroleum industry.

The first chapter discusses in some detail the operation and management of the Russian system and the attitude of the Soviet government toward petroleum and its part in the nation's economy. The fairly detailed map of Soviet Russia, European and Asiatic divisions as well, is included with the various producing districts and industrial centers shown by appropriate boundary markings. A reproduction with English names is shown above. The goals set for 1950, the fifth and last year of the Fourth Five-Year Plan, are given to show the trend; 250 million tons of coal (metric tons?), 35.4 million tons of oil and so on. According to tabulated production values and plans, the Union expects to produce 60 million tons of oil—about 400 million bbl—in 1960.

The history of the industry is traced briefly from the earliest records to the present, taking up the production records of the various fields, Maikop, Grosny, Baku, etc. Foreign investments under the Czarist regime are shown, which credits England with having invested 360 million goldmarks or around $90 million before the Bolshevist Revolution. Several maps of individual producing fields are shown.

Of especial interest is the discussion of the Russian industry's problems, the nature of which is implied by subchapter titles:

Is the petroleum supply of Russia adequate for the country's needs without aid from the production of other countries?

What factors determine the Soviet oil supply?

Could the Soviet oil industry be throttled without damage to the political economy?

Is the steel supply for the (Russian) oil industry assured?

Can synthetic oil production become an important contribution to Russian oil supplies? * * *

*Petroleum in the Soviet Union

† Published by Industrieverlag von Hernhaussen K. G/Hamburg 11, Germany. Price DM 5.80. Pages, 176.

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 32nd YEAR

Take a look Inside . . .

and see why the Baash-Ross Roller Kelly Bushing is so unusually efficient!

Important Performance Facts on the Industry's Most Famous Bushing

Baash-Ross Roller Kelly Bushings are setting such outstanding performance records wherever they are in service that a constantly increasing number of oil men are asking for more information on the "fine points" of roller bushing design. The following are typical of questions we are frequently asked in the field. Perhaps your question is answered here. If not, our engineering department will be glad to explain to you the engineering "why" of any point you wish to ask about.

Q Why use *two* rollers in contact with each kelly face? Wouldn't one large roller on each face serve as well?

A. Definitely not. Two rollers give vertical stability to the kelly—prevent it from gyrating and wobbling—hold it steady at *all* table speeds and under *all* drilling conditions, rough or smooth

One roller on each face would not give this vertical stability . . . would permit the kelly to wobble and gyrate over a wide arc—which, in turn, would not only reduce drilling speed and efficiency, but would also cause severe strains on table bearings, swivel bearings and pipe connections.

Another important point—one roller for each face would necessitate the rollers being quite large in order to prevent "corrugating" the kelly. Large rollers mean high inertia—are slow to start, slow to stop and prevent instant response to kelly feed. But by using two rollers against each face, ample driving surface is secured with rollers that are compact, quick-turning, quick-stopping. Result—*instant response to the most delicate bit feed!*

One roller permits wobble

Two rollers maintain alignment

Bronze bushing prevents steel-to-steel contact

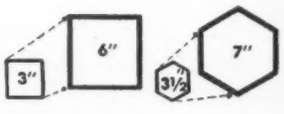
Q Why do you use a bronze bushing between each roller and pin? Wouldn't it be easier to simply use larger pins and eliminate the bronze bushings?

A. It would be easier, yes . . . but not good engineering. The bronze bushings serve a very important function by preventing steel-to-steel contact between rollers and pins. As most engineers know, steel against bronze gives a much better bearing surface than steel-on-steel. It not only resists galling under higher loads, but also carries more efficiently the heavy driving pressures set up between the pins and rollers.

And speaking of the pins, here's another valuable design feature . . . Because there is no pressure (therefore no wear) on the back side of the pins, these have been designed so that they can be easily reversed to bring the unworn back side to the front for additional life after the front sides are worn. Cuts maintenance to a minimum and insures peak performance *longer* without replacements.

Q Do you need a separate Baash-Ross Roller Bushing for each size kelly?

A. No. The same bushing can be quickly changed from one kelly size to another by merely lifting out the roller assemblies—which come in sets—and replacing them with a new set of the desired size. It's simple, fool-proof, *quick* . . . and cuts kelly bushing investment to a minimum. For example, the same Baash-Ross Bushing will fit *all* square kelly sizes from 3" to 6" by simply changing roller assemblies. Or, when using Hex kellys, the same Roller Bushing will fit all Hex sizes from 3½" to 7" by changing only the assemblies.



Q It's a well-known fact that close bushing fit is important when using Hex kellys. Can you maintain close fit with the Baash-Ross Roller Bushing for Hex kellys?

A. Absolutely! In fact, the Baash-Ross Hex Roller Kelly Bushing is designed so that all you do to adjust the fit is lift out the roller assemblies and remove one or more shims below each assembly. Working diameter is reduced exactly 1/32" for each shim removed, so it's easy to make accurate adjustment without complicated operations.

Get the complete story on Baash-Ross Roller Kelly Bushing advantages before you invest in any bushing. Your near-by Baash-Ross representative will be glad to supply further details on this modern bushing—or write direct for full information.

Caterpillar diesel D7 tractor equipped with No. 7A bulldozer pulls track type trailer with gas pipe for distribution along right-of-way cleared through timber in rough country to site of recently completed well. Working in Trawick field.

Caterpillar diesel D7 tractor equipped with No. 7A bulldozer and Hyster winch are excavating for drainage culvert on access road to new oil well drill site.

DEVELOPING NATURAL GAS FIELD

Natural gas has ceased to be a by-product in such areas as Trawick gas field near Cushing, Texas, where producer and contractor work together—pioneering, grading, and stringing pipe.

Along with similar developments, this shows one reason why the natural gas industry topped the billion dollar mark in 1946 and still continues to grow. Production in terms of cubic feet has doubled during the past 10 years.

Heavy earthmoving equipment supports the success of natural gas producers. In the hands of contractors like Reynolds and Huff, Tyler, Texas, such equipment speeds up site preparation, moving of drill rigs, building of access roads, and pipe stringing.

On the Trawick Gas Unit No. 11, Reynolds and Huff send in an advance crew to fell and remove pine trees. Then a "Cat" D7 tractor with bulldozer roughs out the access road, clearing away stumps, limbs, and other debris. Shown working in swampy gumbo, this machine also carries a Hyster worm drive winch for the job of moving heavy drill rigs.

Another machine prepares the site, clearing, leveling, and excavating for the boiler pit.

Meanwhile, work continues on the mile of access road to the new drill site. A "Cat" No. 12 motor grader smooths the right-of-way, while a Northwest dragline loads trucks with gravel for surfacing.

Following through, two other D7 tractors clear the way to string a gas line from the completed well, then haul the pipe sections over rough terrain with the aid of an Athey tractor-trailer.

At last reports Reynolds and Huff had standardized 100 per cent on "Caterpillar" power, including seven motor graders, six track-type tractors, and two northwest cranes with "Cat" D318 engines. Maintenance is simplified by the fact that, except for one veteran R5 tractor, all equipment is powered by one of two sizes of diesel engines. ★ ★ ★

Caterpillar diesel D318 engine provides power for this Northwest dragline loading trucks with gravel to be used on oil field access road to new well site.

NEWS

Reservoir Conditions Are Studied in West Texas

The Texas Railroad Commission is studying the Scurry County reef fields of West Texas, in an attempt to ascertain just how much oil can be produced from the prolific fields. Output on the wells was cut back per-well allowables from 160 bbl a day to 100 bbl a day last December, when the reservoir pressure decreased considerably.

It has been predicted by William J. Murray, Jr., commissioner, that present methods of recovery would lift one barrel in every seven in the reef reservoir, and one barrel in 10 in the Sprayberry formation. Murray added that more oil exists in place in Scurry County than exists in place in the East Texas reservoir, but from East Texas approximately 5½ billion barrels would be produced compared with about 1 billion barrels that will be produced in Scurry County due to present reservoir conditions and recovery methods.

San Juan Oil Buys Producing Properties

San Juan Oil Company, Dallas, Texas, according to its president, Robert J. Bradley, has acquired from Boyd, Hardey, and Wheelock, Teague, Texas, the producing properties formerly owned by the Olson Drilling Company, Tulsa, Oklahoma. Arthur O. Olson announced the dissolution of the Olson Drilling Company. That company will be continued by Olson as an individual, without change in the company name. No change in the field personnel or the policy of the company is expected.

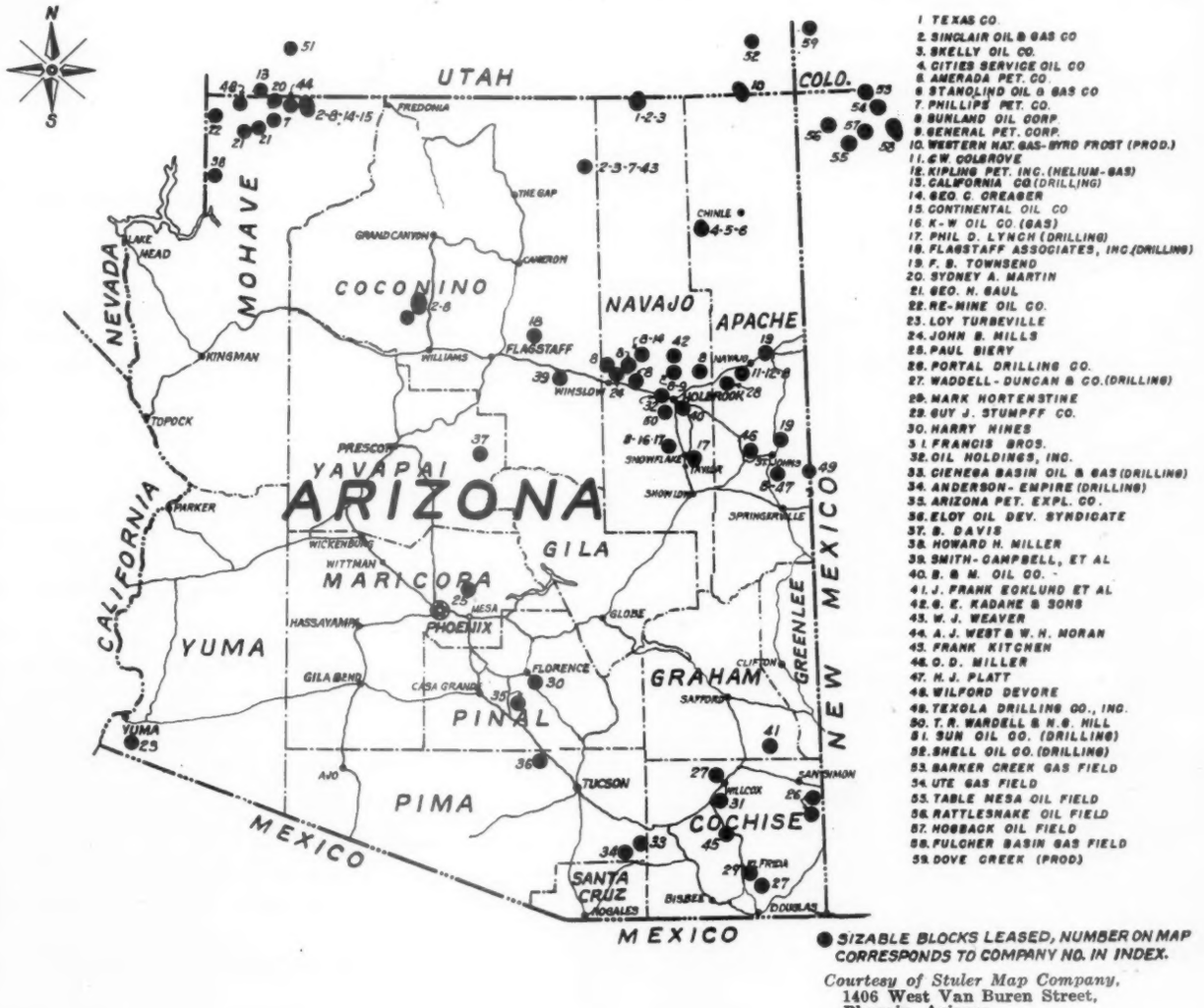
Bradley stated that the properties acquired included approximately 140 wells in Illinois, Kansas, Oklahoma, and Texas. With the acquisition of these properties San Jaun Oil will now be operating approximately 475 oil and gas wells with a gross production of approximately 5,000 bbl per day. The company was formed a little over one year ago by Bradley and Laird and Company, Wilmington, Delaware, for the purpose of acquiring the former Mudge Oil Company and since that date has expanded by outright purchases of production, in addition to an active development drilling program.

Prior to the formation of the company, Bradley was petroleum economist for DeGolyer and MacNaughton, geological consulting firm of Dallas, Texas.

Phillips Petroleum Sets New Record for Safety

For the first time in Phillips Petroleum Company's 34-year history, a producing division has completed 1,000,000 man-hours without a disabling injury, according to an announcement by K. S. Adams, chairman, and Paul Endacott, president.

The Western division, which includes the Big Spring, Texas; West Texas; and Hobbs, New Mexico, districts, reached its goal on July 25. The safety period required two and one-half years to complete, having begun on February 8, 1949. M. R. Hayes is division superintendent, having succeeded D. A. Miller, who was recently elevated to regional superintendent.

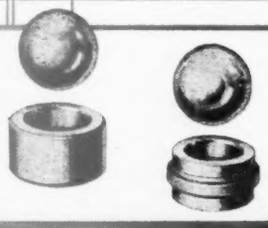


Courtesy of Stuler Map Company,
1406 West Van Buren Street,
Phoenix, Arizona.

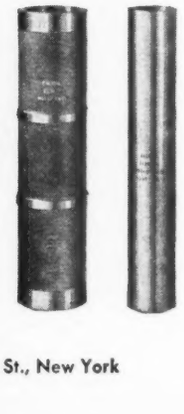
Map of Arizona. Shows latest leasing and developing in that state. A large portion of this development and leasing has taken place since the new Arizona Oil and Gas leasing law came into existence.

by Pacific PUMPS INC.

	QUESTION		ANSWER
Q	*Why is oil at the bottom of the well like money in a safe deposit box?*	A	Because it is a LIQUID ASSET IN DEAD STORAGE WITHOUT EARNING POWER.
Q	*Can this condition be changed?*	A	Yes — both can be activated and given earning power.
Q	*How can they be activated?*	A	Draw some of the money from the safe deposit box — purchase and install a Pacific Oil Well Plunger Pump in the well — pump the oil to the surface. MONEY IN CIRCULATION — OIL IN CIRCULATION — BOTH WITH POWER TO EARN.
Q	*Why purchase and install Pacific Oil Well Plunger Pumps?*	A	Because only Pacific gives you the EXCLUSIVE MOLOY® LINERS with the strength, toughness, hardness, combined with greater resistance to temperature, corrosion and abrasion essential for long, economical life.



Plungers — Chrome-Plated then Pacilited for extra wear life.
Valves and Seats — To fit well conditions.
Extra Heavy Seats — Resist hammering of ball with less chance of distortion.



PACIFIC *Precision Built* PUMPS

DW-6

Pacific Pumps inc.
ONE OF THE DRESSER INDUSTRIES

HUNTINGTON PARK, CALIFORNIA
Export Office: Chanin Bldg., 122 E. 42nd St., New York
Offices in All Principal Cities

Alabama Oil Production Up in First Half of 1951

The Alabama State Oil and Gas Commission has reported that oil production in the first half of 1951 totaled 490,747 bbl.

During the month of June, 91,850 bbl of oil were produced. Oil is produced from the West Gilbertown and East Gilbertown pools in Choctaw County, the original discoveries, which have 26 and 41 wells respectively; Carlton field in Clark County, with 7 wells, and the South Carlton pool of Baldwin County, which was 1 well.

Engineering Manual Available to Public

A 16-page mannual of recommended "Engineering Standards for Multiple V-Belt Drives," as approved by the Rubber Manufacturers Association, Inc. and the Mechanical Power Transmission Association is now available to the public. Data is based on the latest engineering opinion and research. The manual indicates the proper sheaves and belts to be used for the attainment of optimum efficiency and economy.

This manual of standards may be obtained for $1 for two copies from either the Multiple V-Belt Drive Association, 7 West Madison Street, Chicago 2, Illinois, or The Rubber Manufacturers Association, Inc., 444 Madison Avenue, New York 22, New York.

European Geophysicists Form Own Society

The West European Geophysical Union has been formed according to A. Van Weelden, chief geophysicist for Battafshe Petroleum Maatschappij (Dutch Shell) of The Hague, Holland. He added that plans are under way to affiliate this Union with the Society of Exploration Geophysicists as the "West Europe Local Section."

One - hundred thirty - six exploration geophysicists residing in various countries of Western Europe and 38 members of the Society of Exploration Geophysicists make up the initial membership.

Organizational meeting was held at the Third World Petroleum Congress recently, at which time a temporary constitution board was elected. This board consists of Dr. A. A. Fitch, of Seismograph Service, Ltd., London; Dr. E. H. Redstrom, of The Electrical Prospecting Company, Stockholm; L. Migaux, of Compagnie Generale de Geophysique, Paris; van Weelden; Dr. B. Baars, also of B.P.M., The Hague; and Dr. A. Schleusener, of Seismos, Hannover.

Venezuelan Oil Output

Colon Development Company, Ltd. has reported that its total production in Venezuela amounted to 361,473 bbl for the four weeks ending July 30. Production for the five weeks ending July 2, amounted to 449,262 bbl.

Kuwait Oil Production Hits New Record Level

The world's richest oil field, that of Kuwait's will soon be producing 700,000 bbl daily of crude oil, in an attempt to make up for the shortage created by Iran's oil problems. The field was developed by America's Gulf Oil Company and Anglo-Iranian Oil Company. Customers who once bought oil from Iran, are arriving in Kuwait, seeking another source of oil.

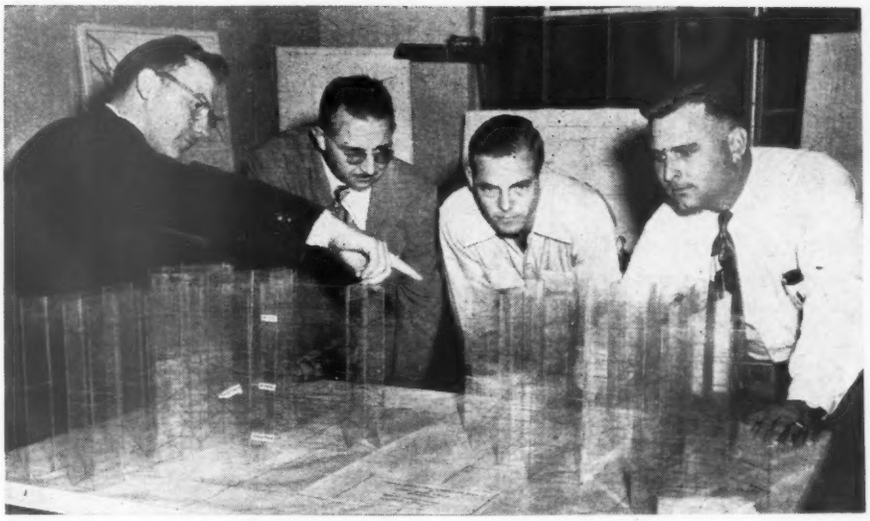
Georgia Publishes Booklet On Its Oil Possibilities

The Georgia State Oil and Gas Commission has published a 4-page booklet entitled "Oil Possibilities in Georgia." Georgia, which does not have any commercial production, has since 1945 granted permits for the drilling of 24 exploratory wells. In Early County the Mount Warren well was carried to a depth of 7320 ft, passing through the Mesozoic and Cenozoic rocks, but without reaching granite. In Pierce County, however, two wells reached basement at 4375 and 4355 respectively.

Garland Peyton, state geologist, says: "The Lower Cretaceous rocks have been added to Georgia as a result of recent drilling. This adds a new geological period and over 3000 ft of possible oil-producing rock. Deep drilling has demonstrated the presence of Triassic rocks. The occurrence of nearly horizontal and gently dipping undeformed Paleozoic sediments beneath the Coastal Plain of south Georgia and northwest Florida offers additional interesting opportunity. Three main subsurface structural divisions are suggested in Georgia—the Gulf Embayment, the High Divide, and the Atlantic and West Indian section."

C. W. Deming, former director of the Georgia Oil and Gas Commission, says: "In regard to oil probabilities southeast Georgia is being seriously considered for future deep sand drilling with especial reference, at this time, to the Okefenokee Swamp area, this consideration being greatly heightened recently by the decision of the Interior Department that the government holdings could be leased. A spokesman from the Gulf Research Corporation, Pittsburg, has been extensively quoted to the effect that underlying the Cretaceous there are possibilities in the Paleozoic at an estimated 18,000 ft.

The bulletin adds that geologists believe that the best opportunities for discovery of oil are in the Paleozoic area. These rocks have been mapped by the Georgia Geological Survey, where a total thickness of about 20,000 ft has been estimated for the Paleozoic section.



New view of an oil field shown Venezuelan production men. J. B. Currie, left, geologist of Gulf Oil laboratories in Pittsburgh, Pennsyvania demonstrates a three-dimensional Lucite model of the Heidelberg field, Mississippi, to R. V. Tailleur, mud technician; W. M. Sanders, engineer pipe line; and J. V. Todd, foreman production, all of Mene Grande Oil Company, C.A., in Venezuela. The trio was among 250 representatives from throughout the world who attended a Gulf Production Engineering Conference in Pittsburgh recently.

Mississippi Oil Output Up Engineering Report Shows

The Mississippi Oil and Gas Board has issued its 1950 Petroleum engineering report on the oil and gas reservoirs of Mississippi. The book contains much factual data on oil industry of that state, as well as diagrams and production statistics of each field in the state.

This 1950 report states that oil output increased 356,549 bbl in 1950 from 1949, making last year's total 38,241,669 bbl. Gas production amounted to 161,134,226,000 cu ft an increase of 52,155,744,000 cu ft over the previous year. About 38,500,000,000 cu ft of gas was injected into the producing horizons in the Brookhaven and Cranfield fields, and salt water production increased to about 39,700,000 bbl.

In the back of this engineering report the wells are listed individually, giving the completion date, annual production of water, oil, and gas for 1950, cumulative production of water, oil and gas, to January 1, 1951, and the date of abandonment if a well is no longer producing. Three hundred and five wells were drilled, compared to 349 wells in 1949, and of the 128 wildcat wells drilled 8 resulted in the discovery of new oil or gas fields, the books states.

Salvatori to Equip Geophysical Laboratory

A gift received by Stanford University from Henry Salvatori, president of Western Geophysical Company of America, will be used to equip a geophysical laboratory at Stanford, it was announced by President Sterling. Dr. Sterling said the laboratory, an addition to the school of mineral sciences facilities, will be situated in the Petrography Building and will be named in honor of the donor.

Dean Charles F. Park, Jr. of the school of mineral sciences said that the new laboratory, is being used to investigate mineral resources through a study of the physical properties of the earth's crust.

European Oil Shale Is Subject of B of M Booklet

The United States Department of the Interior, Bureau of Mines, has published a booklet titled "The Oil-Shale Industries of Europe" by Boyd Guthrie and Simon Klosky. The 73-page bulletin contains 65 figures, and describes the oil-shale industries of six European countries—Scotland, Sweden, France, Spain, Germany, and Estonia. Technical data on the oil-shade operations in these countries were obtained by Bureau of Mines technologists visiting the oil-shale mines and plants in each of these countries except Estonia. Literature obtained, before Germany and now Russia took the country in their sphere of domination supplied data for this country.

The authors report that Scotland produces over 1,000,000 tons of shale a year; Sweden processes over 1,000,000 tons of oil shale a year, producing refined products and byproducts that compete with imported materials; France's production is not quite as high as that of Scotland and Sweden, but plant capacity is being expanded; Spain has one small plant in operation and plans a large one; Germany had one small plant in operation before the war and two others planned, however, none are producing now; Estonia was the leading producer of shale oil in Europe in 1938. The industry declined under German occupation; it is now in the hands of the Russians.

WHAT'S DOING IN DRILLING

Standard Texas to Deepen Abandoned Texas Wildcat

Standard Oil Company of Texas has announced its plans to deepen its No. 1 Joe E. Kelieher, wildcat failure in Hale County, Texas. The well will be deepened to 11,000 ft for a test of the Ellenberger. The project in Callihan County school land, was plugged and abandoned by Standard in 1947 at a total depth of 8010 ft in Pennsylvanian lime.

Rocky Mountain Area Leads Completed Well Averages

At the end of the first six months of 1951, 146 exploratory wells have been drilled in the Rocky Mountain oil region, about 66 per cent more than the same period last year, according to Petroleum Information, statistical firm. Depths totaling 729,913 ft in 1951 compared with 354,840 ft in the first half of 1950. Colorado led states in the region in drilling activity with 49 attempts, but Wyoming, with 7 oil producers out of 45 completions, led in the discoveries. The firm reported that this was a higher completion average than the national average.

New Well Indicated In Lincoln, Mississippi

Mississippi may soon have one of the best oil producers it has had in several years in the West Lincoln field of Lincoln County. It is the Roeser and Pendleton and Pan American Production Company's No. 1 Barney Grice. On final three hours of a six-hour drillstem test, the well flowed at the rate of 528 bbl of oil per day through ¼ in. tubing. Working pressure was 1040 lb. Oil was found in the Lower Tuscaloosa. The well was bottomed at 10,690 ft.

West Texas Field to Get Its Fifth Oil Producer

Wilshire Ellenburger field in Upton County, Texas will soon get its fifth producer, indications show. New well is Wilshire Oil Company's No. 23-129 McElroy Ranch Company, which flowed 130 bbl of 54.2 gravity oil, with 0.1 per cent drilling water in three hours. Flow was from open hole at 12,018 ft. Seven-inch casing was set to 12,143 ft, total depth. Gas-oil ratio was 608-1.

Magnolia to Drill Mississippi Field Test

Magnolia Petroleum Company has made final arrangements for a new Wilcox test in the Kingston field of Adams County, Mississippi. Slated for a 6800-ft test, is the company's No. 1 Westbrook-Foules Unit. Kemp Drilling Company will do the drilling.

Engine shelter can be hinged for easier handling.

How to Support Engine Shelter on Derrick

On a jackknife rig being operated in a field where it is feasible to skid the unit between locations, considerable time and work is saved by hinge-mounting the engine shelter to the derrick, so that the entire roof member pivots around its line of attachment to the derrick.

In normal running, the shelter rests on posts set into sockets in the engine platform, and may be secured to these posts if danger of high winds exists.

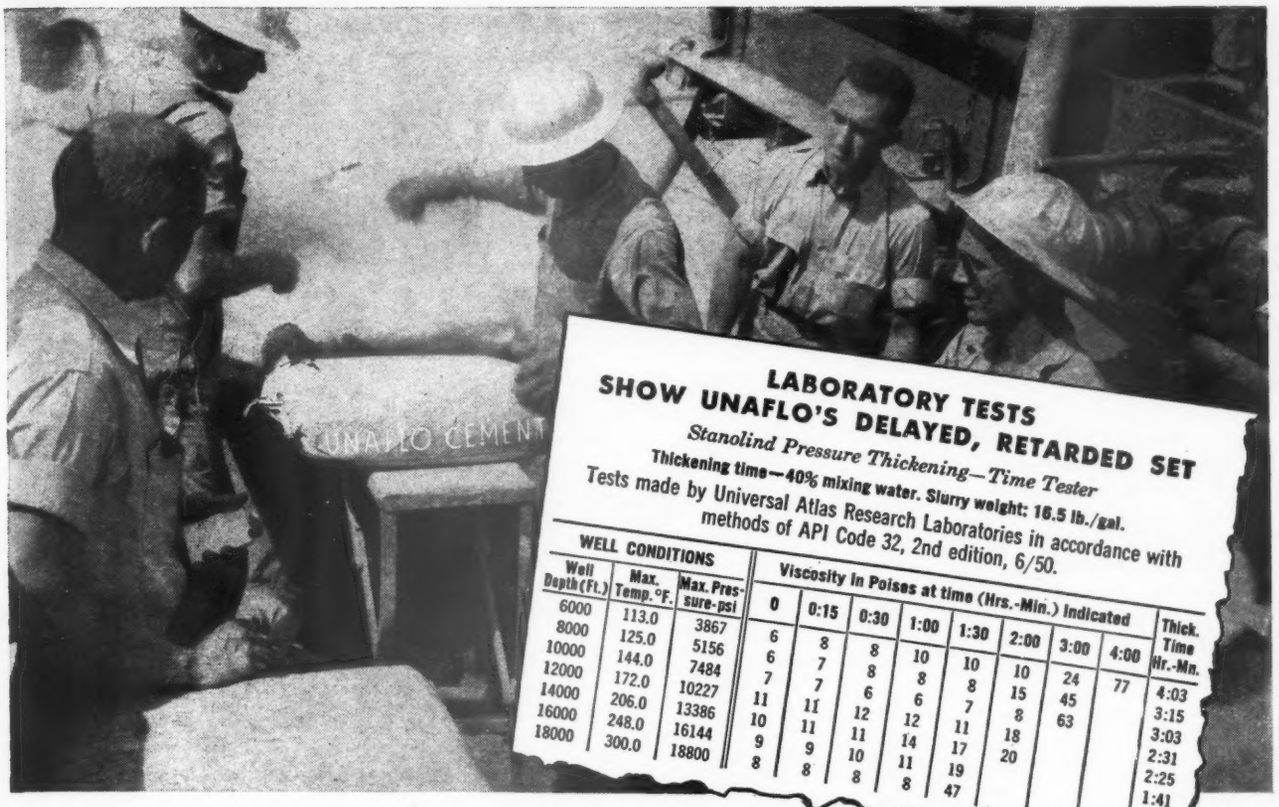
In addition to the support of the roof on the hinge bolts and floor posts, it is equipped with two quarter-inch wire lines, attached at the outer corners of the roof, and carried to points some five girts above the hinged edge where they are made fast to the derrick angles. At their outer ends, these lines carry turnbuckles with 12 or more inches of take-up.

If the derrick is to be skidded, the turnbuckles are tightened to raise the outer edge of the roof off of the supporting posts, and the unit carried by the wire lines and hinged section to the new location. Arrived there, with the engine platform again in place, it is easy to anchor the roof by slacking off on the turnbuckles and thus allow the roof to contact the posts. For a long haul or in case of wind, the roof may be folded against derrick.—E. S.

Rotary rigs operating in oil fields of United States and Canada*

WEEKS (JULY)	TOTAL	Gulf Coast	Pacific Coast	Illinois Oklahoma Kansas	Arkansas Louisiana Texas	Rocky Mountain Canada	New Mexico West Texas
Fourth	2748	594	146	633	164	297	914
(AUGUST)							
First	2796	596	160	640	160	317	923
Second	2800	590	163	637	157	320	933

*As reported to the American Association of Oilwell Drilling Contractors by Hughes Tool Company.



LABORATORY TESTS SHOW UNAFLO'S DELAYED, RETARDED SET

Stanolind Pressure Thickening—Time Tester

Thickening time—40% mixing water. Slurry weight: 16.5 lb./gal.

Tests made by Universal Atlas Research Laboratories in accordance with methods of API Code 32, 2nd edition, 6/50.

WELL CONDITIONS			Viscosity in Poises at time (Hrs.-Min.) indicated								
Well Depth (Ft.)	Max. Temp. °F.	Max. Pressure-psi	0	0:15	0:30	1:00	1:30	2:00	3:00	4:00	Thick. Time Hr.-Mn.
6000	113.0	3867	6	8	8	10	10	10	24	77	4:03
8000	125.0	5156	6	7	8	8	8	15	45		3:15
10000	144.0	7484	7	7	6	6	7	8	63		3:03
12000	172.0	10227	11	11	12	12	11	18			2:31
14000	206.0	13386	10	11	11	14	17	20			2:25
16000	248.0	16144	9	9	10	11	19				1:41
18000	300.0	18800	8	8	8	8	47				1:33

hot squeeze . . . deep squeeze . . . delayed squeeze

you're safer with UNAFLO*

With a *squeeze* on for increased production, you need the protection of Unaflo Oil-Well Cement. It gives you *vital extra time* to complete a squeeze job . . . and it may save your well if delays crop up.

Unaflo isn't just another "slow-setting" cement. A slurry of Unaflo stays fluid and pumpable throughout the retardation period. That has been proved in the laboratory (see chart above) and in hot, deep holes all over the world.

So whether you're cementing a new well—or bringing an old one back into profitable production—use Unaflo. It's good judgment to insist on the cement that gives you this reliable protection:

EASY FLOWING — Unaflo's high initial fluidity makes pumping easier.

SUSTAINED FLUIDITY—Unaflo stays *fluid* and pumpable throughout the retardation period. There's ample time, even in emergencies, to get the cement in place.

HARDENS NORMALLY—Unaflo, after its retarded period, makes a strong formation bond and tight seal—resistant to sulfate waters.

• • •

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Atlas Portland Cement—Type I

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PE-U-122

"THE THEATRE GUILD ON THE AIR"—*Sponsored by U. S. Steel Subsidiaries—Sunday Evenings—NBC Network*

PAD Explains Method Of Allocating Steel

Fears of California oil producers that insufficient drill pipe and casing were being allocated to them by the Petroleum Administration for Defense, have brought an explanatory letter from R. G. Lawton, PAD Director of Production, which details PAD's allocation method.

The letter was addressed to E. E. Pyles, vice president of Jergins Oil Company, who, with R. M. Blodget, executive vice president of Oil Producers Agency, reported to PAD in a conference in Washington that operators in California apparently were receiving too little steel to enable them to carry on the drilling program necessary to maintain the required oil supply on the Pacific Coast.

In his letter of explanation, Lawton said that:

"1. An operator is granted enough tonnage under good practices to allow him to drill in the 3rd quarter of 1951 one-fourth of his 1950 program in footage at his indicated increased depth for 1951.

"2. If the operator is a traditional carrier of inventory, the tonnage above is then doubled to allow the operator a 90-day working inventory, in addition to his program as outlined above.

"3. Allowance is also made for the extra weight and grade necessary for such areas as California, Gulf Coast, Rocky Mountains, Appalachian, and West Texas-New Mexico deep drilling.

"4. An operator is then granted in line with other operators, additional tonnage as required to expand his program over his 1950 operation, if he has justified need for expansion, up to the limit of steel available for this purpose.

The estimate of steel requirements made by California producers indicated a consumption rate of about 36,000 tons per quarter during the first half of this year. It pointed out that to the extent that current PAD allocations fell short of this amount, operators had been forced to withdraw tubular goods from inventory and that inventories in many cases were nearing exhaustion.

Shell Forms New Colorado Division

Shell Oil Company has created a new division known as the Colorado division, with headquarters in Denver. The division will cover southwest South Dakota, southwest Wyoming, Nebraska panhandle, eastern Colorado and Northeastern New Mexico.

J. E. Gray, formerly of Centralia, Illinois is to be division production manager; J. W. McDonald, Tulsa, Oklahoma, division geologist; W. S. Henry, Tulsa, division land agent; D. D. Peters, division attorney; R. H. Miller, district production foreman; E. H. Shiels, drilling foreman; A. H. Weider, division exploitation engineer; J. M. Sykes, chief clerk; U. H. Capron, chief clerk of the exploration department, and F. R. Versaw, geophysicist.

Spraberry Area Extended In Reagan County, Texas

Sohio Petroleum Company has extended Spraberry production around the corner of Midland, Upton, Glasscock, and Reagan counties in West Texas. The well is the No. 1 E. B. Williams, situated in the northwestern section of Reagan County, Texas. It has been completed for a daily flowing potential of 604 bbl of 38.8 gravity oil through a 42/64-in. choke from open hole between 6747 ft. The section was treated with 1500 gal of hydrafrac.

IOCC Studies Unitization

The Research and Coordinating and Secondary Recovery Advisory Comittees of the Interstate Oil Compact Commission have begun a project to bring up to January 1, 1951, the information on unitized and cooperative projects in the U. S. Chairman G. E. Eddy, of the Research Committee, and Paul D. Torry, Secondary Recovery Committee, have chosen a subcommittee to take charge of this project. They are: Thomas Winfiele, Louisiana Department of Conservation, chairman; Jack Baumel, Texas Railroad Commission; Massena Murray, Oklahoma Corporation Commission; John A. Anderson, U. S. Geological Survey; Ralph Schilthuis, Humble Oil and Refining, and William L. Horner, Sunray Oil Corporation.

New Production Sought In Old Louisiana Field

Justiss Mears Oil Company is attempting a revival of production in the old Beekman field of Morehouse Parish, Louisiana. Their No. 1 Crossett Timber and Development Company tested salt water and oilcut mud from 3703-3709 ft before 5½-in. casing was run to 3815 ft. Total depth is 3953 ft. Later the well tested an unreported amount of oil in the Cotton Valley. Discovery well for the field was the Union Producing Company A-1 Crossett Lumber and Development Company. It has been shut in for some time.

Sinclair Completes New Oklahoma Well

Sinclair Oil and Gas Company has completed its No. 2 Hyder Mulky in Grant County, Oklahoma. Drilled to a total depth of 5807, the well flowed 263 bbl of 46.2 gravity oil in 11 hours through a 2/64-in. choke from the Wilcox sand with 618,000 cu ft of gas a day.

California Field Well Completed on Pump

A new well has been completed on the pump in North Antelope Hills field, California by Shell Oil Company. The well was drilled to 2530 ft. Present production is at the rate of 141 bbl daily.

Petroleum Congress Papers for Drilling and Producing

The number of papers given at the World Petroleum Congress held in The Hague were extensive, and went into every phase of the oil industry.

Papers of special interest in drilling and production were: Internal Hydrostatic Pressure Testing as a Measure of the Performance Values of Oil Well Casing and Tubing, H. G. Texter, National Supply Company; A Drillability Classification of Geological Formation, A. L. Head, Jr., Reed Roller Bit Company; Oil Base Drilling Fluids, George Miller, Oil Base, Inc.; Standards for Casing Centralizer Tests, W. S. Althouse, Jr., and E. H. Clark, Jr., Baker Oil Tools, Inc.; Pressure Build-Up in Wells, D. R. Horner, N. V. de Bataafsche Petroleum Mij.; Drilling and Producing Oil and Gas in the Gulf of Mexico, Leigh S. McCaslin, Jr., *Oil and Gas Journal;* Diesel Electric Drilling, Howard L. Shatto, Shell Oil; Drilling Emulsion, R. A. Henkes, Shell Caribbean Petroleum; The Application of Numerical Methods to Cycling and Flooding Problems, C. H. Fay and M. Prats, Shell Oil; Emulsion Drilling Fluids, Doyne L. Wilson, Oil Base, Inc.; Well Cementation, R. P. Moscrip, Shell Oil; Meeting the Problem of Sub-Surface Formation Slippage in the Drilling and Production of Oil Wells, G. M. Anderson, Baker Oil Tools; The Quantitative Interpretation of Radioactivity Logs, R. E. Fearon and E. S. Mardock, Well Surveys, Inc.; The Effect of Particle Size on the Physical Properties of a Gulf Coast Drilling Mud, George H. Fancher, Texas Petroleum Research Committee, professor of petroleum engineering, and S. C. Oliphant, Stanolind Oil and Gas Company; Some Problems of Relative Permeability Measurement, Walter Rose, Gulf Research and Development Company; The Cretaceous Limestone Producing Areas of the Mara and Maracaibo Districts, Venezuela: Reservoir and Production Engineering, M. Stephenson, Shell Caribbean Petroleum; Concerning the Problem of Sensitivity in the Power Control of Drilling Outfits With Hydraulic Torque Converters, Dr. W. Schulz, consulting engineer; Solvent Washing of Wells in the Digboi Field, Assam, H. B. Kale, J. Wylie, and H. R. Tainsh, Assam Oil Company, Ltd.; The Exploitation of Oil-Fields of Extremely High Oil-Viscosity by Wells, Under the Application of Thermal Energy, Adolf K. Winkler, Pram Erdol-Explorations-GmbH.; The Latest Developments and Achievements of Directional Drilling in the Exploitation of Oil Fields, H. John Eastman, Eastman Oil Well Survey Company; Status of the Drill as an Exploration Tool, W. F. Bates, Shell Oil; The Application of Surface Observations to the Study of Underground Conditions in Oil Reservoirs, W. J. Baker, Anglo-Iranian Oil; Three Gas-Bearing Fields in the Po Valley (North Italy), G. Facca, Azienda Generale Italiana Petroli; Polytropic Flow in Gas Wells, Harry H. Power, University of Texas, and James Coull, University of Pittsburgh; Theoretical Considerations of Multi-Phase Flow in Idealized Capillary Systems, S. T. Yuster; University of California; Secondary Recovery of Oil in California, A. G. Loomis and G. B. Shea, U. S. Bureau of Mines; Techniques in the Kirkuk Oilfield, H. A. Freeman, Iraq Petroleum; The Poza Rica Field, Jose Colomo, and Alfonso Barnetche, Pemex; Directional Permeability Trends, Richard V. Hughes, Stanford University; Oil Recovery by Fluid Injection, Paul D. Torrey.

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EXPLORATION ACTIVITIES

New Mexico Well Shows As Ellenburger Discovery

A multiple discovery well is being drilled by Skelly Oil Company, Seaboard Oil Company, and J. C. Maxwell, Inc. in East Lea County, New Mexico. It is the No. 1-J Mexico-State, which is a mile west of the Dollarhide field in Andrews County, Texas. After flowing oil on a test in the Ellenburger zone topped tentatively at 10,140 ft, the well will be drilled ahead in Ellenburger. On a 6-hour drillstem test at 10,175-200 ft, oil reached the surface in 2 hours. In the next four hours the well produced 155 bbl of oil with gas-oil ratio 495 to 1. Maximum flowing pressure was 3500 lb. First oil shows were found in the upper Permian, and the Devonian, and Silurian also showed favorable.

Arkansas Gas Well Shoots Out of Control

A new gas well in Fort Smith, Arkansas has been out of control, and the public warned to stay at least a mile and a half from the site. The wild well is Arkansas-Oklahoma Company well, which reported that gas was erupting through the ground at points as much as 1000 ft from the producer. Drillers have been forcing mud down the main well in an attempt to bring the escaping gas under control. The well was drilled in a previously unexplored section of the Cecil field, and officials report it might prove to the biggest producer in Arkansas.

New Gas Well Reported In Old Chickasha Field

A new well that may double the life of the Chickasha field in Grady County, Oklahoma has been completed by Little Nick Oil Company. The well, the company's No. 4 Glover, is in a deeper high-pressure natural gas zone in the Chickasha gas field. The well was drilled in the center of the old field, and was believed to set a new depth record for the state. No detailed information was released, but Miss Jessie Deering, general manager of Little Nick Oil, announced that the volume was sufficient to predict "that the life of the Chickasha field has been doubled".

Kansas Discovery Indicated

Indications of a good discovery have been found in the Carl Todd Drilling Company's No. 1 Wendelburg, in Stafford County, Kansas. Oil shows were found in the Arbuckle and in the Lansing. In the Arbuckle, a 30-minute drillstem test was made at 3729-3732 ft, recovering 240 ft of clean oil and 10 ft of oily mud. A 43-minute drillstem test of the Lansing recovered 45 ft of heavily oil-cut mud at 3520-3537 ft.

Tests Prove Montana Well Capable of Production

A Shell Oil Company spokesman has announced that initial production tests at its Northern Pacific No. 1 at Richey, Montana have proved that the well is capable of producing substantial quantities of 38 gravity oil. Production operations however, are suspended temporarily while the well is being deepened to explore the extent of the producing horizon.

Mid-Continent Plans Exploratory Oil Well

Mid-Continent Petroleum Company has announced that it will drill an 8000-ft exploratory oil well north and east of Red Wash field in Uintah County, Utah. The company announced that it planned to drill to the base of the Green River formation, the formation that is producing oil at both the Roosevelt and Red Wash pools.

New Gas Discovery Made In Northern California

A new gas discovery has been made in northern California by Honolulu Oil Corporation. The new field was opened with completion of the Wild Goose No. 1, in Butte County. The well was drilled to 4009 ft, plugged back to 3400. Casing was perforated in the interval 3292-3314 ft, yielding a gas blow of 3,500,000 cu ft daily on a flow test. Nearest gas fields are in the Afton field, nine miles north of Glenn County, and Marysville Buttes field, 9 miles south in Sutter County.

Tide Water Well Drilled In Martin County, Texas

In southern Martin County, Texas, which has been receiving quite a lot of attention lately, Tide Water Associated Oil Company has drilled a new well, its No. 1 E. B. Dickenson.

The new well flowed 20 bbl of high gravity oil an hour through a 1-in. choke on an 18-hour production test. Total depth of the well is 12,140 ft. Test was from perforations made at 12,087 to 12,-105 ft.

Gas and Light Oil Strike Made in Saskatchewan

A new gas and light oil strike has been made by Socony-Vacuum Oil Company, Inc. in Saskatchewan Province, Canada. The wildcat was reported as having a substantial flow of gas and a good showing of light oil at a depth of 3631 to 3661 ft. A Socony-Vacuum spokesman declared it was "the most significant light oil show reported in Saskatchewan to date".

Bibliography Available on Stratigraphic Traps

Seismograph Service Corporation, of Tulsa, Oklahoma, has just published the "Bibliography of Stratigraphic Traps", with annotations, according to G. H. Westby, president of the company, in an announcement by the Society of Exploration Geophysicists. Edited by W. E. Pugh and B. G. Preston, the volume lists in 200 pages geological articles on stratigraphic traps by author, geographical location, and geologic age, respectively. Twenty-five employees of the company, assisted by the staffs of the University of Tulsa geology department and library and the Tulsa Public Library, organized and arranged the 1340 references by 910 different authors. All articles indexed concern the accumulation, or possible accumulation, of oil or gas in stratigraphic traps.

Copies of this publication and "Bibliography of Organic Reefs, Bioherms, and Niostromes," published in 1950 by SCC, can be obtained without charge by writing to Seismograph Service Corporation, Box 1590, Tulsa 1, Oklahoma.

Illinois Well Opens New Producing Area

Carter Oil Company has recently made an important oil discovery in Hamilton County, Illinois at its No. 1 Van Winkle. The well, drilled to a total depth of 3330 ft, opens a new area three miles from other wells. On a 2-hour drillstem test, the well recovered gas in 7 minutes and flowed clean oil in 1 hour and 40 minutes. Tests were made from 3274 to 3284 ft in the McClosky limestone.

Kentucky Oil Field Is Given New Producer

A new well has been drilled in the Robards pool of Henderson County, western Kentucky. It is the Delta Drilling Company's No. 1 Melton, which flowed 1610 bbl of oil in the first 24 hours while testing McClosky lime at 2512-33 ft. Total depth is 2613 ft with hole plugged back to 2535 ft.

New Zone Hit In Kentucky Oil Field

W. Briney and Associates have opened a new producing zone in the Little Zion pool, Ohio County, Western Kentucky. Their No. 3 Hamilton pumped 3 bbl net oil per day. The new area is at 763-88 ft.

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New Strawn Discovery

A new Strawn sand discovery has been made in Clay County, Texas. The new oil well is the No. 1-A G. W. Scaling and others wildcat, drilled by Armour Properties. The well was completed from 4480 and 4500 ft after shooting the section with 40 qt of nitro. On first test, a calculated 344 bbl of 42 gravity oil flowed for 24 hours through a ½-in. choke. Gas-oil ratio was 350 to 1. The well was plugged back to 4506 ft, with 5½-in. cemented at 4478 ft.

Sinclair Well Is Dually Completed

A dual completion has been given Sinclair Oil and Gas Company's No. 1 Vaughn-Lackey Unit, in Garvin County, Oklahoma. The well was plugged back to 7456 ft. It flowed 149 bbl of 40.2 gravity oil through a ¾-in. choke with 497,000 cu ft of gas a day from the Gibson sand through perforations between 7386-7424 ft. Both tests were of 12 hours duration.

West Virginia Gas Well

The Hope Natural Gas Company has a new gas well in Preston County, West Virginia. The new wildcat had a final open flow of 6,000,000 cu ft of gas.

Mississippi Well Seen

Prospects of a new discovery are seen in Franklin County, Mississippi. The new well the No. 1 J. D. Seab is north of the South White Apple field, and has revealed oil sands in 2 zones of the Wilcox. With hole bottomed at 7007 ft, the total of 55 sidewall samples were recovered oil sand in the interval at 6423-31 and at 6465-67 ft. The Anderson sand that produced in the discovery well of the South White Apple field had shaled out.

Sunray Drills Texas Well

Sunray Oil Corporation has a new oil discovery in Starr County, Texas at its No. 1 G. G. Zamora, which had shows of oil in sidewall cores at 6184-95 ft. Gas shows were encountered at 6220-25 ft. Operator is now running casing prior to testing the shows. Plans are to plug back for completion attempts in the Sullivan gas sand around 4350 ft.

Tide Water Brings in West Texas Well

Tide Water Associated Oil Company announced that its No. 1 E. B. Dickenson well in Southern Martin County, West Texas, flowed at the rate of 480 bbl per day on an eighteen-hour test of the Ellenburger Lime from 12,087 ft to 12,105 ft. This is a wildcat well situated on a block of 13,000 acres owned by the company.

Illinois Well Testing

In Clay County, Illinois, Ashland Oil and Refining and A. G. Becker's No. 1 Lee is cleaning out to test the McClosky limestone at 3033 to 3038 ft. Total depth is 3081 ft. On a one-hour drillstem test at 3021 to 3037 ft, gas was recovered in five minutes and 1850 ft of oil with no water. The well is about two miles from other wells.

Standard Texas Well In Pennsylvanian Lime

Standard Oil Company of Texas has indicated it may have a Pennsylvanian lime producing find in Howard County, Texas. The venture is No. 1 H. L. Adams, which got a good recovery along with some salt water on a drillstem test at 9620-47 ft. The test was made for 3 hours, and gas reached the surface in 4 minutes and oil in 30 minutes. Gas showed throughout test.

New Kentucky Oil Area

A new area has been opened in Daviess County, Kentucky, about a mile southwest of Birk City. The new well is the G. L. Reasor No. 2 O. L. Winsatt, which is testing the lower Renault limestone at 1858 and 1864 ft. Total depth is 2008 ft. On a 1-hour drillstem test gas was recovered in 35 minutes and 1800 ft of free oil, and no water appeared.

Florida Wildcat Drilling

Drilling is proceeding at a Florida wildcat test in Collier County. Twenty-five miles southwest of the Sunniland field, Humble Oil and Refining Company is drilling below 11,675 ft at its wildcat, the No. 1 Collier Corporation.

U. S. Steel Develops New Hole Casing

Development of a new, tougher and stronger casing capable of withstanding pressures in deep holes has been announced by United States Steel Corporation. Casing is rolled from a quenched and drawn carbon-manganese steel. Physical properties developed for 7-in. casing were 110,000 lb per minimum yield strength at 0.6 per cent total strain, 139,000 psi average ultimate strength and 22.4 per cent average elongation in 2 in. No cracks in the pipe were found during perforation tests using both conventional gun and jet gun.

World Oil Congress Papers

Exploration was well covered in the World Petroleum Congress program held this spring at The Hague.

Some of the papers of special note under the geology and geophysics section are: Contributions of Bacteria to the Origin of Oil, by Claude E. ZoBell, University of California; Observations on the Geology and Petroleum Occurrences of the Middle East, F. R. Henson, Iraq Petroleum Company; Relationships Between Crude Oil Composition and Stratigraphy in the Forest Reserve Field of South West Trinidad, by K. W. Barr, and R. O. Young, Trinidad Leaseholds Ltd., Frank Morton, University of Birmingham, and A. R. Richards, Caribbean Development Company, Ltd. Geological Aspects of Abnormal Reservoir Pressures in the Gulf Coast Region of Louisiana, U. S. A., George Dickinson, Shell Oil Company; The Cretaceous Limestone Producing Areas of the Mara and Maracaibo District—Venezuela: Geology, J. E. Smith, Shell Caribbean Petroleum; Oil and Gas Development in Alberta, by Oliver B. Hopkins, and E. W. Shaw, Imperial Oil, Ltd.; Seismic Surveys Over Asymmetrical Structures in South-West Persia, by D. T. Germain-Jones, Anglo-Iranian Oil; The Agha Jari Oilfield, South-West Persia, by D. C. Ion, S. Elder, and A. E. Pedder, Anglo Iranian Oil; Stratigraphical Exploration Surveys in South-West Persia, P. E. Kent, F. C. Slinger, and A. N. Thomas, Anglo-Iranian Oil; On the Oil Possibilities of Turkey with Special Reference to the Raman Field, by Cevat Tasman and Necdet Egesan, Geological Society of Turkey; Distribution of Oilfields in the Western Part of the United States, Graham B. Moody, Standard Oil Company.

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How to Safeguard a Doghouse Padlock

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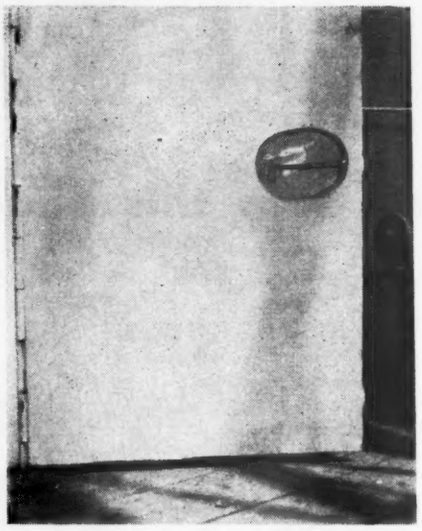
Locking the door is accomplished by a long bar, which swings down behind wards inside the doghouse, and the end projecting within the formed recess then brought into contact with the ear, which carries a hole for the padlock. The lock is passed through bar and locking ear, and snapped shut.

When secured within the recess the padlock is guarded against a hammer blow or cutting with a hacksaw, without any obstacle being offered to the use of the key when the house is to be opened.

Setting the padlock and locking bar within the recess also protects them against accidental damage when the house is being moved.—E. S.



Safe doghouse padlock.

Texaco Well Completed In Lea County, New Mexico

A new discovery is being completed in Lea County, New Mexico by The Texas Company. The No. 1-AS State was drilled to a total depth of 9730 ft, and is 8 miles west of the Saunders pool. The wildcat showed for production from the Wolfcamp of Permian Age on drillstem tests from 9691 to 9730 ft.

Carter Well Successful

The prolific Garvin County in Oklahoma has another good producer, drilled by Carter Oil Company. It is the company's No. 1 Mary Moore, which flowed 85 bbl of new 89-gravity oil to tanks; in one hour gas-oil ratio was 1036-1, and 1205 ft of oil were recovered. Total depth is 7775 ft. Gas showed in 5 minutes on a drillstem test at 7753 ft through a ½-in. bottom hole choke and ⅝-in. top hole choke, and oil in 20 minutes.

San Juan Basin Well May Usher in New Oil Boom

A new well, the Thomas W. Doswell's No. 2 Scott Federal in San Juan Basin, New Mexico may be the beginning of a fresh oil boom in the northwestern part of the state. The well flowed 720 bbl of gravity oil a day on official gage. It was found in an 85-ft section of Tocito sandstone in the Mancos shale, which has not been regarded as a likely prospect for oil heretofore. Production is from 6607 to 6692 ft, along with 460,000 cu ft of gas a day.

New Louisiana Field Open

A wildcat flowing 210 bbl of 24.8 gravity oil daily through 9/64-in. choke has opened a new oil field in Arcadia Parish, Louisiana. The well is Bates and Cornell's No. 1 Mrs. Lawrence E. Frey, which is producing from perforations at 9438-46 ft. Tubing pressure was 850 psi.

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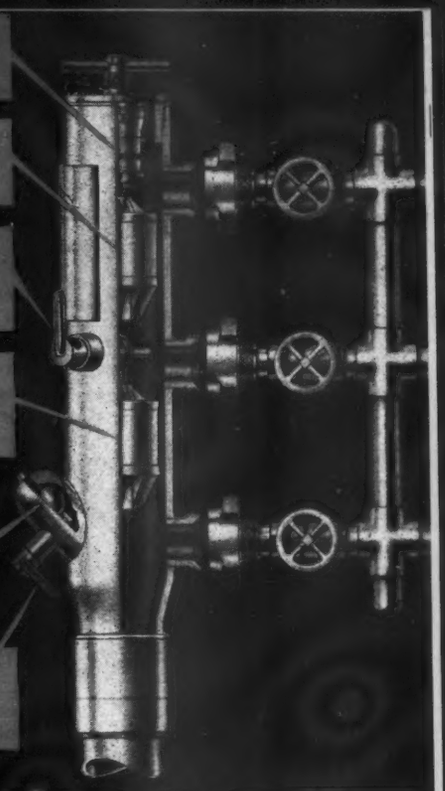
From HEAD to SHOE


Back pressure valve connected to top plug.
Top plug rides cement column down the casing.
Plug bar releases bottom plug without shutting down or opening head.
Bottom plug leads cement column and wipes casing clean of mud.
Trip ball that ejects float assembly in shoe to provide full casing-bore discharge.
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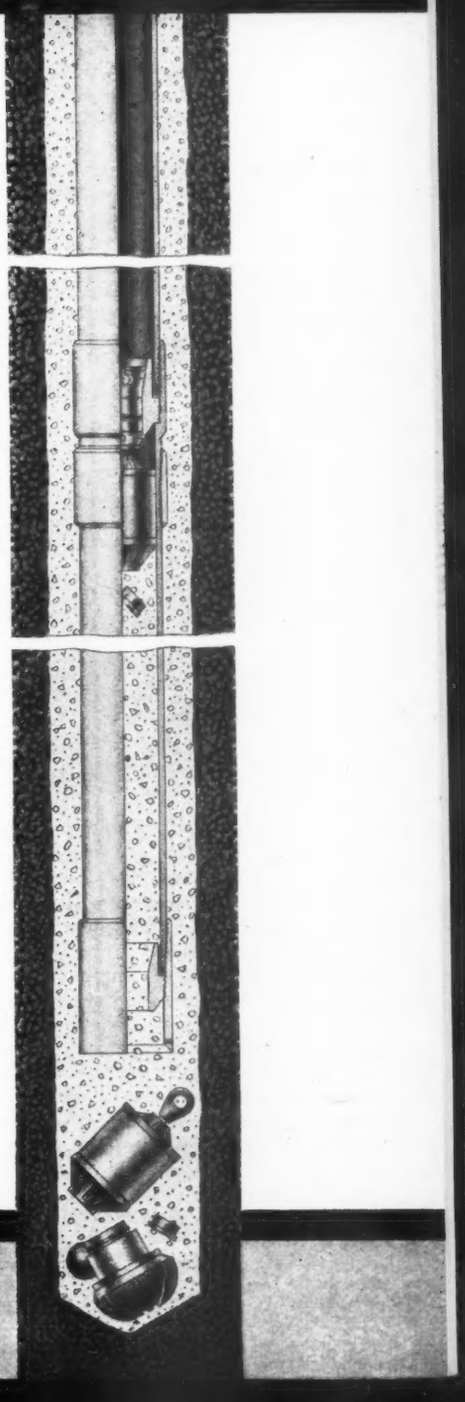
Extreme simplicity is another advantage of "Fulbore" cementing. There are no discs to break . . . no small orifices through which the cement must be pumped. Traveling ahead of the cement, the bottom plug is pumped out of the casing through the float shoe from which the float assembly has been ejected after cementing string has been floated into position. This provides full casing discharge capacity . . . reduces the load on the pumps . . . permits greater volume to be circulated with same pump discharge pressure . . . results in higher velocity in space between casing and bottom of hole.

Every phase of "Fulbore" cementing is planned to make every job a master cementing job. Ask your Rector Representative or authorized supply store for full information about "Fulbore" Cementing and equipment.



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Running tour with men in the industry

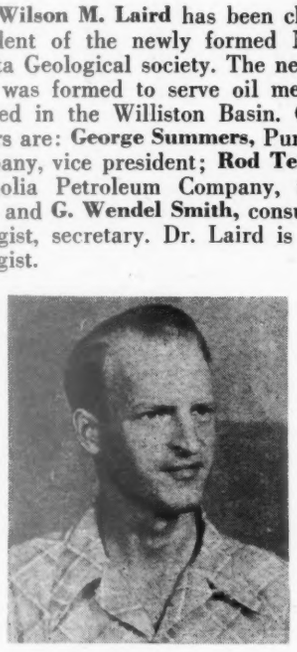
R. G. Greene has been named manager of exploration for Union Oil Company's Western area, embracing the Pacific Coast, Rocky Mountain, and Canadian divisions. He will be responsible for all land acquisitions there. He has been manager of exploration in the Pacific Coast division since 1949.

John R. Sloat succeeds Greene as manager of exploration for the Pacific Coast division. **Lon D. Cartwright** will continue in charge of Union's exploration activities in the Gulf and West Texas divisions as well as unassigned and foreign areas. He will also serve as liaison with United Geophysical Company.

Greene was educated as a geologist at Cornell and Stanford. He joined Union Oil in 1929 for exploration work in Venezuela.

Sloat was graduated from M.I.T. in 1934. For the next three years he served as a geophysical party chief in Texas, Kansas, Colorado, and California. He joined Union Oil in 1938.

Dr. Wilson M. Laird has been chosen president of the newly formed North Dakota Geological society. The new society was formed to serve oil men interested in the Williston Basin. Other officers are: **George Summers,** Pure Oil Company, vice president; **Rod Tetrick,** Magnolia Petroleum Company, treasurer; and **G. Wendel Smith,** consulting geologist, secretary. Dr. Laird is state geologist.



Ray S. Waterman

Ray S. Waterman has joined Kirkpatrick and McGuire, consulting petroleum engineers, of Shreveport, Louisiana. Waterman attended the University of Illinois College of Engineering and the Georgia School of Technology.

He served four years with the Arkansas Fuel Oil Company and following this he was employed by the Arkansas-Louisiana Gas Company in Shreveport, Louisiana for three years. Waterman will be engaged in reservoir engineering work specializing in water-flood projects and appraisals of oil and gas properties.

O. E. Gram, area geologist, **L. L. Crozier,** area landman, will be in charge of all the Oklahoma operating activities of the land and exploration department of Deep Rock Oil Corporation. All operating activities will be consolidated in an Oklahoma City office. **Charles D. Moore,** formerly with Stanolind Oil and Gas Company, also has been added to the Oklahoma City staff as geologist. **H. L. Curry** and **R. W. Bayliss** will continue to handle scouting activities from the new location.

In the division's headquarters at Tulsa, **Charles W. Lane,** who has been area geologist for southern and western Oklahoma and assistant to the geology manager, has been appointed technical and administrative assistant to the vice president. **I. S. Higginbotham,** longtime Deep Rock employee and recently Tulsa area geologist, has been named new assistant to the geology manager.

C. J. Harvey, geophysical manager, gained an assistant manager, **Harry M. Cooper, Jr.,** a graduate of Ohio State University and Carnegie Tech, who comes to Deep Rock with varied seismic experience.

Robert D. Gensch, also a former Tulsa area geologist, has moved to Wichita, Kansas, as area geologist to reopen the company's offices in the Petroleum Building of that city. **Kenneth Holke,** recently with Cooperative Refinery Association, joins the new office as assistant geologist.

In the Rocky Mountain area, the Sterling, Colorado, office is being closed and a new one opened at Casper, Wyoming. Former Sterling geologist, **R. J. Field** and scout, **R. G. Boekel** are being moved to Denver and **M. R. Reston,** scout and landman, has been transferred to Casper. The Denver office is headed by **W. C. MacQuown,** area geologist, and **E. E. Nowell,** landman.

K. V. (King) Schroeder has been appointed manager of Sun Oil Company's land department in the Gulf Coast division. He will continue in his present position as chief geologist, at Beaumont, Texas. **Herbert Parker,** also of Beaumont, has been appointed assistant chief geologist. Schroeder, a graduate of Colgate University, joined Sun's production department at Beaumont in 1936, working as a roustabout at Anahuac, Seabreeze, and Nome until his transfer to the geological department in the Beaumont office in 1937. He was made chief geologist of the division in 1948.

Parker joined Sun in 1937 as a research computer in the seismograph department. In 1945 he was promoted to seismograph supervisor, a position he held until 1947, when he was transferred to the geological department. He is a University of Kentucky graduate.

R. C. Tucker

R. C. Tucker, vice president of George P. Livermore, Inc., and Great Western Producers, Inc., of Lubbock, Texas, has recently been named president and general manager of both organizations by the board of directors of the companies. The new president succeeds **George P. Livermore** who announced his resignation several weeks ago. Livermore will continue his participation in the companies as a member of the board of directors.

A native of Parkersburg, West Virginia, Tucker brings 32 years of oil industry experience into his new position. The past 19 years have been spent in the industry in West Texas. He came with George P. Livermore, Inc., and the Great Western Products, Inc., on January 1, 1945, as vice president, and has served in that capacity until his recent elevation to the presidency.

J. E. Swearingen has been appointed general manager of production of the Standard Oil Company (Indiana) at Chicago, Illinois. Swearingen has been a director and assistant to the executive vice president of Stanolind Oil and Gas Company at Tulsa, Oklahoma.

He joined Standard (Indiana) in 1939 as a chemical engineer in the research department at Whiting, Indiana. After holding several positions in Standard's research department, he was transferred in 1947 to the manufacturing department of Stanolind. Early this year he was transferred to Stanolind's general office in Tulsa and soon was elected a director.

Swearingen was graduated from the University of South Carolina and Carnegie Institute of Technology.

Stanford L. Myers has been appointed equipment and safety supervisor of Southern Geophysical Company. Formerly with Stanolind Oil and Gas Company for more than 9 years, Myers will make his offices in Fort Worth. He will be in charge of all equipment of Southern Geophysical in eight states, and will supervise the safety program of the Southern Geophysical crews.

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SAVE TIME, MONEY and PIPE

With McCullough Jet Back-Off Tool or String Shot Service and the One and Only Magna-Tector!

Pipe is scarce and rig time is costly. What could be more economical than backing-off the pipe, recovering all free pipe above the stuck point in one piece, and getting it done in a fraction of the time?

Yet there are limitations in the use of only ONE back-off tool in attempting to free stuck drill pipe, drill collars, subs, casing, tubing and wash pipe. NO ONE TOOL can accomplish EVERY back-off job. But there are TWO back-off tools and between the two, EVERY TYPE of back-off job CAN be accomplished!

That is why McCullough crews arrive at your well with both the McCullough Jet Back-Off Tool and String Shot. These tools plus the McCullough Magna-Tector, that quickly and accurately locates the stuck point, represent an extremely versatile combination service designed to save you time, money and pipe.

These are NOT mechanical tools or fishing tools. They are progressive tools, electronically controlled for accuracy and speed. They are responsible for the sharp decline in fishing in recent years, permitting wells to be drilled faster—saving oil operators thousands of dollars!

HOW YOU SAVE TIME, MONEY AND PIPE

1. TIME SAVER
   a. Accuracy of the McCullough Magna-Tector in locating the stuck point consistently, eliminates unnecessary back-off shots.
   b. New, high-temperature, high-pressure resistant detonators in the back-off tools eliminate misruns.
   c. These electric wire line tools are run into and out of the well in a fraction of the time required with mechanical cutters.
   d. In addition they are electronically controlled permitting greater speed and accuracy than ordinary electric wire line tools.
   e. Electronics also provides MORE information about conditions in the well—locating collars, tight places, fluid level, etc., both audibly and visibly.
2. MONEY SAVER
   a. McCullough Back-Off Service accomplishes ANY TYPE of back-off job, leaving the fish in good condition for subsequent operations.
   b. The use and need of a rotary table is eliminated.
   c. McCullough Magna-Tector, many times, indicates that working and spotting oil will free the pipe, eliminating the need of backing-off and fishing.
   d. Guesswork is eliminated.
3. PIPE SAVER
   a. Eliminates cutting and damage to the pipe.
   b. Permits recovery of all free pipe in one piece and the freeing and recovery of all stuck pipe in undamaged sections.

WHAT TO DO

When your pipe becomes stuck—CALL McCullough IMMEDIATELY! The McCullough Magna-Tector will quickly locate the lowest free point, the stuck point and do it accurately. Then the McCullough Back-Off Service will free all loose pipe in one piece—simplifying the fishing job.

Since time is important McCullough Back-Off Service is fast. All free pipe will be removed BEFORE it can stick further up the hole.

No two stuck pipe conditions are exactly alike. This is another reason why you NEED McCullough VERSATILE Back-Off Service. The complete equipment, the skill of experienced McCullough crews, and the special techniques they have devised WILL SAVE YOU TIME, MONEY AND PIPE!

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▸ **Eugene S. Pennebaker, Jr.,** Humble Oil and Refining Company senior petroleum engineer, has been transferred from petroleum engineering division, Houston, Texas office, to Southwest Texas division office. **Ralph K. Hill,** petroleum engineer, was transferred from the Gulf Coast division office to petroleum engineering division, Houston office, as senior petroleum engineer.

Charles D. Enrhardt, Jr., petroleum engineer, moved from Friendswood district, Gulf Coast division, to petroleum engineering division, Houston office, as senior petroleum engineer. **Norman A. Nelson,** senior petroleum engineer, was transferred from the petroleum engineering division, Houston office, to Friendswood district, Gulf Coast division.

Samuel T. Sikes, Jr., supervising petroleum engineer, transferred from the petroleum engineering division, Houston office, to Gulf Coast division office.

Jeremiah Ward III, senior petroleum engineer, moved from Gulf Coast division office to East Texas division office as supervising petroleum engineer. **Willis P. Orr,** senior petroleum engineer, transferred from petroleum engineering division, Houston office, to Hawkins district, East Texas Division.

Charles S. Yust was transferred from petroleum engineering division, Houston, to California district, Gulf Coast division, for work as toolpusher.

William Thiebaud, toolpusher, was transferred from Winters district, North Texas division, to Avoca district as assistant district superintendent.

The following assistant district superintendents have been transferred within the Louisiana division: **F. L. Lively** from Mallalieu district to North Crowley district, **J. C. Andries** from North Crowley district to Bayou Sale district, **H. Durst III** from Bayou sale district to Mallalieu district.

District chief clerks transferred within the Louisiana division are: **E. D. Cole** from Eucutta district to Avery Island district, **A. M. Ferguson** from Bayou district to Mallalieu district, **E. E. Setser** from Mallalieu district to Bayou district, **Jack Pierce** from North Crowley district to Eucutta district, **H. M. Davidson** from Avery Island district to North Crowley district.

The following promotions and transfers were made in the West Texas division: **P. M. McFadden,** assistant district superintendent, was promoted to district superintendent in the McCamey district, **Delma Baucum,** assistant district superintendent, Snyder district, was named district superintendent, Wink district.

J. P. Baldridge, farm boss, became assistant district superintendent in the Hobbs, New Mexico district, **C. M. Boatman,** assistant district superintendent, was transferred from the Hobbs district to the McCamey district.

C. C. McNeil, assistant district superintendent, transferred from the Wasson district to the Odessa district, **W. A. Watson,** assistant district superintendent, moved from the Odessa district to the Snyder district.

A. J. Shaw, farm boss, Hobbs district, was promoted to assistant district superintendent, Wasson district, **A. M. Torrance,** toolpusher, was sent to the Hobbs district, Garland Deaton, toolpusher, was transferred to the Means district, **E. F. Cole,** toolpusher, was transferred to the Wink district. **D. E. Hoover** was promoted to farm boss in the Hobbs district, **S. B. Carlson,** farm boss, was transferred to the Hobbs district, **B. R. Guyton** gangpusher, Wink district, was promoted to farm boss, McCamey district.

V. J. Fletcher, gangpusher, Odessa district, was promoted to farm boss in the Means district.

R. M. Gillette, district chief clerk moved from the Wasson district to the Hobbs district, **A. D. Eady,** district chief clerk, was transferred from Hobbs district to the Odessa district.

C. W. Thorp, district clerk, Means district, was promoted to assistant district chief clerk, Odessa district. **W. J. Young,** assistant district chief clerk, was transferred to the Snyder district. **R. B. Shanan,** assistant district chief clerk, Wasson district, was promoted to district chief clerk. **A. D. Blakeney,** assistant district chief clerk, transferred to the Wasson district. **S. D. Pittman,** district clerk, was promoted to assistant district chief clerk in the Wink district.

Humble established a new district recently at Stanton in the West Texas division under the supervision of **M. M. Rogers,** district superintendent, and **R. M. Lilly,** assistant district superintendent. Other supervisors transferred to this district included: **A. D. Duncan,** toolpusher, **R. M. Mosley,** farm boss, **M. L. Weatherall,** district chief clerk, **J. C. Wiseley,** assistant district chief clerk, **J. L. Robinson,** assistant district chief clerk.

▸ **Donald Towse** has been appointed assistant professor of geology at the University of North Dakota. Towse, formerly with Amerada Petroleum Corporation at Casper, Wyoming, is studying the sub-surface stratigraphy of the state for the North Dakota Geological Survey. He will also do consulting work in the Rocky Mountain region.

▸ **Robert S. Breitenstein,** geologist for The Texas Company, in Farmington, New Mexico, has been transferred to Fort Worth, Texas. He will serve in the same capacity in Fort Worth.

▸ **John Rulison** has been elected president of the Michigan Geological Society, succeeding **Willard Sanger,** Pure Oil Company. Rulison is with the Michigan Department of Conservation. **George Thomas,** Ohio Oil Company, has been elected vice president of the society; **Margaret Applegate Kitchen,** Sun Oil Company, secretary-treasurer, and **A. E. Slaughter,** is business manager. Slaughter is also a member of the Michigan Department of Conservation.

▸ **Emil Kluth,** representative from Santa Fe Springs, has been elected chairman of the administrative committee of the Conservation Committee of California Oil Producers. Kluth is also vice president of Pacific Western Oil Corporation. Other members of the administrative committee are **R. A. Holman, E. A. Gray, Sol Alexander,** and **T. W. Bell.**

An engineering board was also elected to study oil field performance and conservation. **M. D. Hughes,** representative from Wilmington field Harbor area, and chief petroleum engineer for the city of Long Beach, was elected chairman. Other members elected were **M. G. Arthur, T. H. Acres, D. E. Koch, O. W. Chonette, H. F. Power, H. F. Dangberg, Wm. L. Hobro, R. N. Ayars,** and **S. A. Patterson.**

The new standing subcommittees will serve for one year.

▸ **David Moore** has joined Hancock Oil Company as head of its new Rocky Mountain offices at Casper, Wyoming. He was formerly with Superior Oil Company. With him in the new offices will be **Vance Katherman,** who has left Brinkerhoff Drilling Company as geologist.

▸ **Darrel L. KirkPatrick,** has opened consulting offices in Bakersfield, California. He was formerly district geologist for Chanslor-Canfield Midway Oil Company in San Joaquin.

▸ **Albert Thalman,** geologist for Phillips Petroleum Company at Corpus Christi, Texas was recently transferred to Amarillo, Texas, where he will serve in the same capacity.

▸ **John H. DeFord,** consulting geologist and independent oil operator, opened offices in Abilene, Texas recently. He will be associated with **C. T. McLaughlin,** drilling contractor and oil operator of Snyder, Texas. DeFord, who formerly had offices in Midland, was division geologist with Bay Petroleum Corporation until he became an independent operator in 1950.

▸ **A. W. Wood** has been named superintendent of the southern division of Lion Oil Company. He was formerly with the Phillips Petroleum Company, in the production department.

Sinclair Makes Strike In Rank Wildcat Area

Sinclair Oil and Gas Company's No. 1 Turner Lumber Company in Avoyelles Parish, Louisiana has indications of being a Wilcox discovery in rank wildcat territory. The well was cored at 11,724-69½ ft in the Wilcox, and the entire 45½ ft section gave signs of gas.

It was indicated that the sand would produce gas and condensate. Another sand was cored at 11,811-29½ft, and had indications that it would produce gas and condensate.

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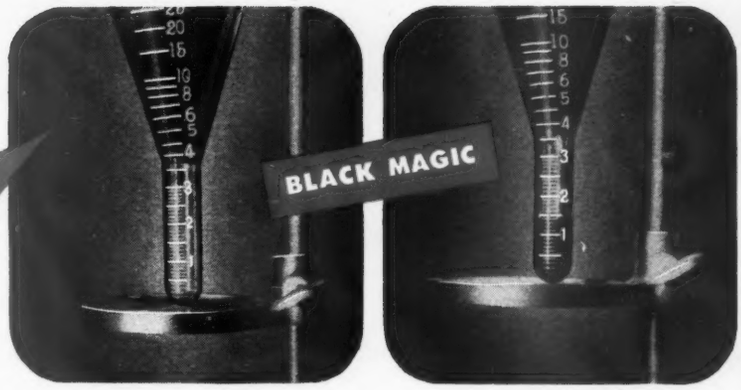
under high temperatures and high pressures



Zero fluid loss at room temperature. 1.3 c.c. fluid loss at 250°F.

NATURE OF THE FILTRATE—*No water. Slightly colored diesel oil with small amount of oil soluble asphalt in solution which is entirely soluble in crude oil. Nothing here to cause trouble. By the addition of a small quantity of plastering material (OB Gel) this fluid loss can be reduced to zero.*

Zero fluid loss at room temperature. 2.5 c.c. fluid loss at 250°F.

NATURE OF THE FILTRATE—*Dark colored diesel oil containing sodium silicate, sodium tallate, and 0.1 c.c. water. Sodium silicate is used to make cement reservoirs, sands, etc., impervious to oil. Sodium tallate forms an insoluble precipitate when in contact with calcium and magnesium salts under certain conditions. A filtrate of this nature would be extremely difficult to remove from the pores of an oil sand formation.*

0.4 c.c. fluid loss at room temperature. 1.7 c.c. fluid loss at 250°F.

NATURE OF THE FILTRATE—*0.6 c.c. crude oil containing a polyvalent resinate and 1.1 c.c. water. Water is used to kill wells and its damaging effects to producing zones is now common knowledge. Polyvalent resinates may be precipitated from the filtrate by contact with a crude oil having different properties. This insoluble resinate in the oil zone can well cause a definite blocking action.*

There are three commercial oil base muds available today. This simple laboratory test was made to compare the performance of all three under pressure and temperature. Samples of each mud were taken directly from wells during drilling. An ordinary API-size filter press was used. All tests were made at 100 p.s.i. for a period of 60 minutes—*All tests were identical*—It is safe to assume that what occurred here also takes place under actual drilling conditions. For more information on these tests write for free copy of Third World Petroleum Congress paper—"Oil Base Drilling Fluids."

What this test means

An oil base mud is used to complete wells to prevent water "blocking" and "mudding off" of the oil zone, to combat heaving shale, for diamond coring, for its better plastering ability and for improving drilling conditions in general. If the mud has a high fluid loss, it defeats its own purpose. A filtrate has the ability to carry clay particles, weighting materials etc., and the greater the filtrate loss of the mud, the thicker the mud cake deposited on the walls of the hole. If harmful, insoluble filtrates are also deposited to block the oil bearing formation, then nothing constructive has been accomplished. A serious fluid loss also causes viscosity and oil make-up problems to further complicate matters.

To get greater production from your wells, to avoid mud maintenance difficulties, use Black Magic—the only drilling mud that stands up under severe well conditions when others fail.

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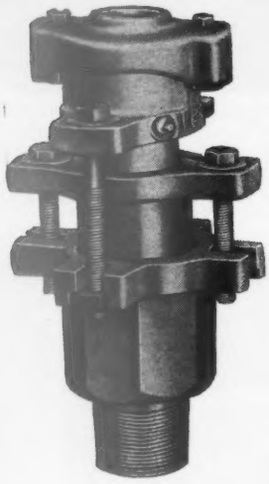

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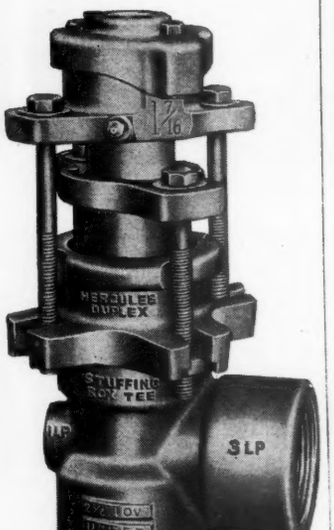
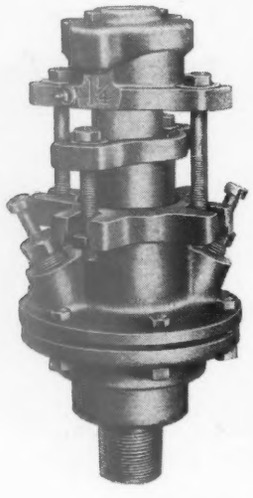


A double packed Stuffing Box for use under most adverse pumping and flowing conditions (below). Be sure to order Type A-123-SBDP.



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▸ **Dan Kralis** and **J. C. Stamm**, co-owners of the Geo-Service, consulting geological firm in Abilene, Texas, recently announced several new additions to their staff. They are: **Percy Prout**, who was former district geologist for Mid-Continent Oil Company, Texas; **Tom Witty**, a graduate of the University of Oklahoma in geology; **Bill Roper**, formerly geologist with Pan American Oil Company; **Walford Popejoy**, graduate geologist of the University of North Dakota; **Bill Womack** and **Bill Bourland** graduate geologists of Texas Technological College; **Aubrey Ott**, graduate geologist of Southern Methodist University; **Bill Garms**, graduate geologist of University of Colorado, and **Andrew Warner**, graduate geologist of University of Texas.

▸ **A. W. Hughes**, geologist for Union Oil Company of California, Los Angeles has retired from the company. He is associated with Dr. P. P. Goudkoff as a consultant, with offices in Los Angeles.

▸ **Albert R. Russell** recently left for Saudi Arabia to join Arabian-American Oil Company. He has resigned his position with Shell Oil Company's exploration drafting department in Midland, Texas.

▸ **Louis H. Michaelson**, Texas Gulf Producing Company, has been promoted to division geologist for the Permian Basin of West Texas and Southeast New Mexico. A Texas Gulf employee for three years, Michaelson was formerly in the geological department of Skelly Oil Company at Midland, Texas. He succeeds **Charles C. Green**, who resigned.

▸ **Dr. Roy R. Morse** was named consultant to Standard Oil Company (Ohio). His headquarters will be at Regina, Sask., Canada. After 26 years' service with Shell Oil Company, Morse retired last January. During his time with Shell he had been exploration manager, manager of the Texas-Gulf area, and director of exploration for Shell's East-of-the-Rockies region. He will report directly to **Earl D. Wallace**, vice president in charge of production.

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Mother of Chemical Empires

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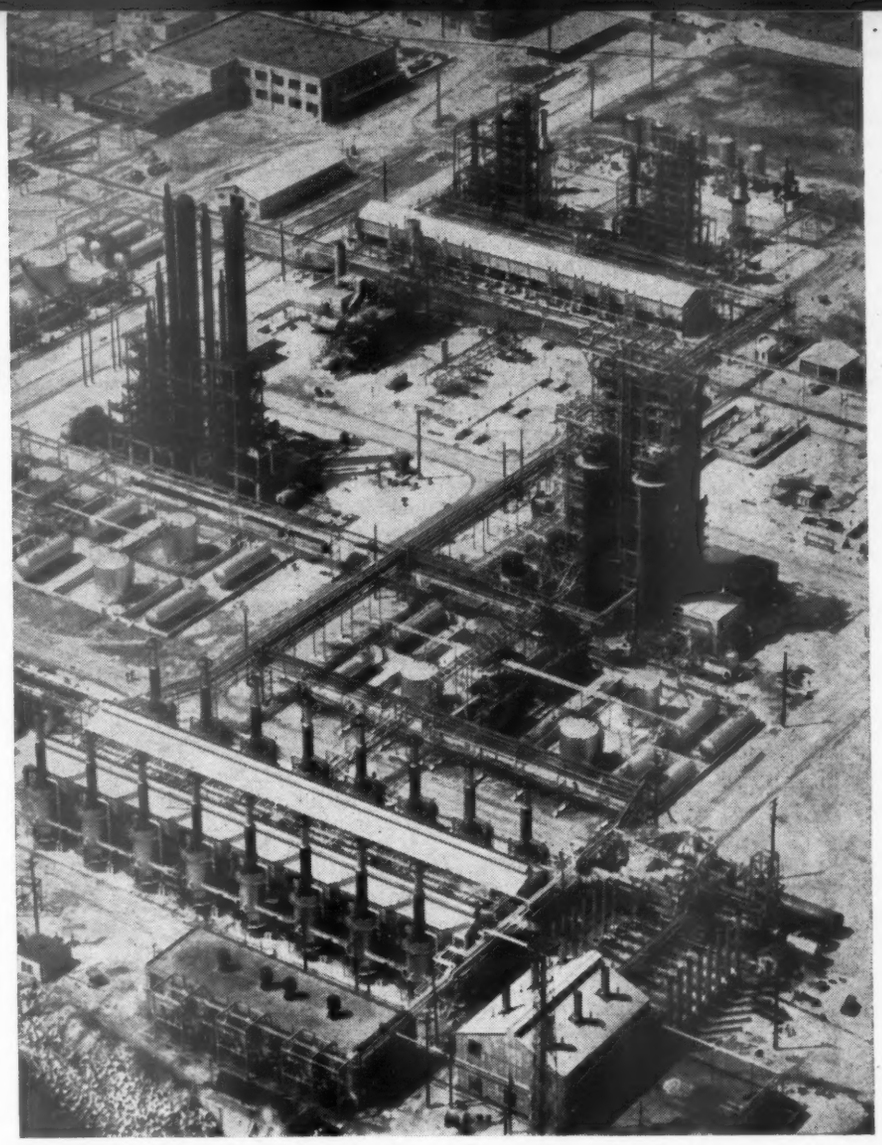
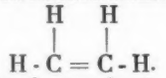


Styrene is made in this Monsanto plant at Texas City, using benzene and ethylene extracted from cracked gases from a nearby refinery.

WITHOUT a doubt the huge major portion of petrochemical production as of now is derived directly or indirectly from ethylene as primary intermediate. Ethylene, obtained by cracking ethane, propane, or in thermal and catalytic cracking operations from heavier hydrocarbons as a byproduct, is one of the more difficult olefins to produce by cracking; ethane is highly refractory as compared to heavier hydrocarbons, and propane oftentimes offers a better source of ethylene, structural formula

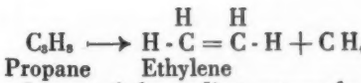


Progress in the production and utilization of ethylene has been more than rapid in the postwar period, although the movement had its beginnings much earlier. In the accompanying list are shown most of the chemical plants in this country that produce either ethylene in commercial quantities, or that use the olefin as a major intermediate. These companies in many cases are subsidiaries of or combined by two larger companies, an oil company and a chemical company. This combination brings into collaboration scientific and chemical engineering talents of technologists from both industries and appears to ensure profitable and intelligent operations.

In addition to these companies, every refinery which operates cracking equipment of either thermal, catalytic, or both processes is a potential producer of ethylene in industrial amounts, and it is certain at present that the greater quantities of this olefin are made as byproduct, from refinery operations not as a primary material. Among the refineries that have been supplying olefins, especially ethylene, to chemical companies for synthesis of a large number of commercial compounds are Standard Oil Company, New Jersey; Standard of Indiana at Whiting; Shell at Wood River, Houston, and Martinez, California; Humble at Baytown, Gulf at Port Arthur, The Texas Company at Port Neches, and others.

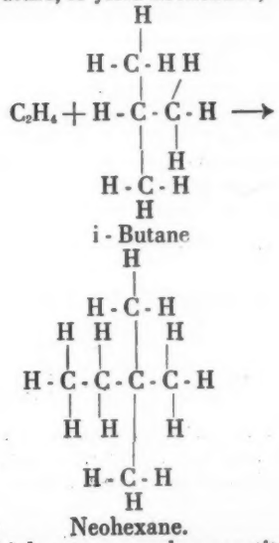
More recently units have been designed and either are building or are in operation for the dehydrogenation of ethane and other light hydrocarbons as primary product. The new plant under construction by Gulf Oil at Port Arthur, building in conjunction with the huge 230,000 bbl per day refinery at the same location, is designed, however, to operate on so-called 'waste' gases from the plant's main operations, a process much cheaper than if ethane-propane mixtures are cracked directly. The design capacity for the Gulf unit is announced to be about 2.5 billion cubic feet (180,000,000 lb) of ethylene per year, a figure that will boost the national total annual ethylene production to values of the order of 22 to 23 billion cubic feet. This ethylene will be consumed locally in chemical plants built or building by Koppers Company for the synthesis of ethylbenzene en route to styrene, and for synthesis of other chemicals by such companies as Jefferson Chemical Company nearby, a subsidiary of The Texas Company and American Cyanamid.

In the nature of things, the number of applications of ethylene to chemical syntheses is legion. One of its earliest uses commercially in this country was and is the production of neohexane by Phillips Petroleum Company at Borger, Texas, using a thermal process with isobutane. Ethane-propane fractions are cracked thermally at high temperatures, most of the ethylene coming from the preponderance of propane in the mixture probably according to the equation,



Propane Ethylene

In one of the earliest extremely high pressure large-scale commercial operations this ethylene and isobutane were heated together without catalyst at upwards of 4000 psig and 900 F or higher temperature, to yield neohexane,



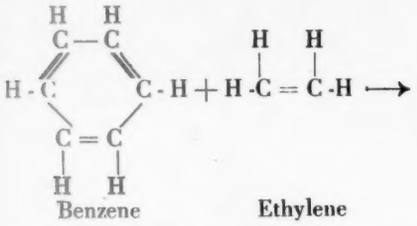
Neohexane.

As a high octane number constituent of

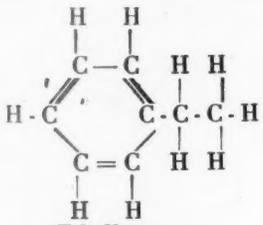
*Editor, Refining and Gas Processing.

aviation fuel before and during World War II, neohexane from this synthesis is one of the real pioneer products in the preparation of modern aviation fuels. It is synthesized entirely without catalytic aid.

One of the largest uses of ethylene is in synthesis of styrene, second main constituent of GR-S or tire-type synthetic rubber. Ethylene made by direct cracking or most commonly as a byproduct of refinery cracking operations is combined with benzene by the 'dislodgement' of one benzene hydrogen by the olefinic double bond, the hydrogen satisfying one carbon bond, the other joined directly to a carbon in the benzene nucleus, yielding ethylbenzene; (Friedel and Crafts reaction);



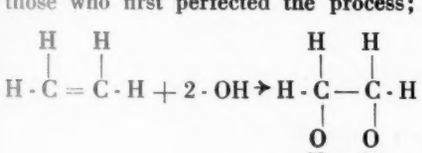
Benzene Ethylene



Ethylbenzene

The ethylbenzene is cracked thermally under carefully controlled conditions to remove two hydrogen atoms from the ethyl side chain and reproduce the olefinic bonding, which is the reactive linkage in polymerization with butadiene to form synthetic rubber.

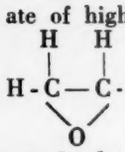
Another commercial synthetic product that has been on the market for several years is ethylene glycol, such as manufactured by duPont and by others from ethylene as intermediate. Industrially, glycol, or the glycols of various molecular weights and carbon nuclei, are intermediates in many chemical syntheses, for the addition variously of two or more carbon-atom chains with one or more hydroxyl groups to other complexes for making dyes, and innumerable other chemicals of the greatest importance in many lines. Theoretically the formation of glycols from ethylene or its homologues is simple, practically the synthesis offered some problems to those who first perfected the process;



Ethylene glycol.

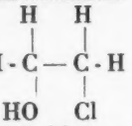
This product under various trade names is known best as a relatively non-volatile anti-freeze for automotive engine cooling systems.

From the viewpoint of an intermediate of high reactivity, ethylene oxide,



ant simple products made from the olefin. This product may be obtained in several ways, among them the formation

of ethylene chlorhydrin,

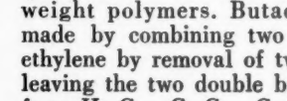


by the interaction of steam, chlorine, and ethylene under the proper conditions, or by mixing alkali carbonates, chlorine, and water with the olefin, or by other known methods. Hydrochloric acid is then eliminated from the chlorhydrin by the use of an alkali such as potassium hydroxide to give the oxide as shown. Other methods are known for making the oxide, including that in which an excess of the olefin is mixed and heated with oxygen or air under carefully controlled conditions.

Ethylene oxide so produced is employed as an intermediate in the preparation of dyes, to add an ethyl or ethoxy group to a dye base, and in a large number of other syntheses in which the ethyl or ethoxy groups play an important role.

Ethylene also is or may be employed in the synthesis of acetic acid and its anhydride, acetone, and other ketones containing ethyl groups; glycols, ethers, chlorides, dichlorides and other halides; dichloroethyl ether, ethylidene chlorides and the mono, di, and trichloroethylenes, polyethylene glycols, etc.

Also one of the outstanding fields in which ethylene is employed in huge quantities is that of high molecular weight polymers. Butadiene can be made by combining two molecules of ethylene by removal of two hydrogens, leaving the two double bonds intact to form



1, 3-butadiene.

In addition benzene can be synthesized by combining three ethylene nuclei and the elimination of three molecules of hydrogen.

The great bulk of polymerized ethylene goes into polyvinyl plastics, resins, synthetic lubricating oils, viscosity index improvers, and analogous products, many of which are assuming great importance. These products assume a multitude of consistencies, colors, and properties. Vinylite resins are colorless or may be colored to suit the maker's requirements, are hard, rigid, and may be cut or formed into innumerable shapes for as many different purposes. The ethylene nucleus appears to combine with itself as a true polymerization reaction, controlled by the proper reaction conditions to yield almost any desired type of material at the will of the operator. These properties range from colorless or colored liquids of low viscosity on through the lubricating viscosity ranges in which doubtless naphthenes with many different paraffinic side chains predominate, to the solid, transparent, hard resinous or plastic materials. Highly viscous liquids or solids soluble in suitable vehicles are being employed at an increasing rate in lacquers, finishes, and coatings of various sorts.

More recent developments in chemical plants involving ethylene in different ways include the new proposed plant of National Petrochemicals Corporation (subsidiary of Panhandle Eastern Pipe Line Company, and National Distillers), which will extract ethane and LPG hydrocarbons from natural gas en route to Midwest and Northern centers, and will produce ethylene in large quantities, presumably by direct dehydrogenation by either catalytic or thermal processes not yet disclosed. American Cyanamid reportedly has acquired rights to the Dominion (Canadian) Tar and Chemical process for making p-vinyl toluene by adding either acetylene or ethylene to toluene, as a substitute for styrene in rubber and polystyrene type synthetics. Koppers will make ethylbenzene at Port Arthur with coaltar benzene and Gulf ethylene, and ship this to Pittsburgh for thermal dehydrogenation to styrene. Canadian Chemicals Ltd. is building a $40,000,000 plant at Edmonton, Alberta, to utilize refinery gases from plants operating there, concentrating and using ethylene and other olefins. Dominion Tar and Chemical will expand its operations to make ethylene glycol and related products at Montreal, also from refinery olefinic gases. The new British American-Shawinigan Chemicals unit projected at Montreal East will use refinery olefins. Jefferson Chemical Company on the Texas coast is studying the production of ethanolamines as an addition to its glycol, ethylene chloride and oxide lines.

Plants in United States and Canada, producing ethylene or using ethylene in chemical production.

Carbide & Carbon Chemicals Corporation, Texas City, Texas.

Diamond Alkali, Pasadena, Texas.

Dow Chemical, Freeport, Texas.

E. I. duPont de Nemours Company, Orange, Texas.

Jefferson Chemical Company, Port Neches, Texas.

Monsanto Chemical, Texas City.

Shell Chemical Corporation, Houston.

Gulf Oil Corporation, Port Arthur.

Koppers Company (building), Port Arthur, Texas.

National Petrochemicals Corporation, Tuscola, Illinois.

Dominion Tar & Chemical Company, Montreal East, Canada.

Canadian Chemical Co. Ltd. (Celanese) Edmonton, Canada.

British-American-Shawinigan Company, Montreal East, Canada.

Matheson Hydrocarbon Chemical Company, Brandenburg, Ky.

American Petrochemical Corporation, Lake Charles, La. (Proposed).

Pontiac Refining- Chicago Corporation, Corpus Christi, Texas. (Proposed).

Hancock Oil Company, Long Beach, Calif. (Proposed). * * *

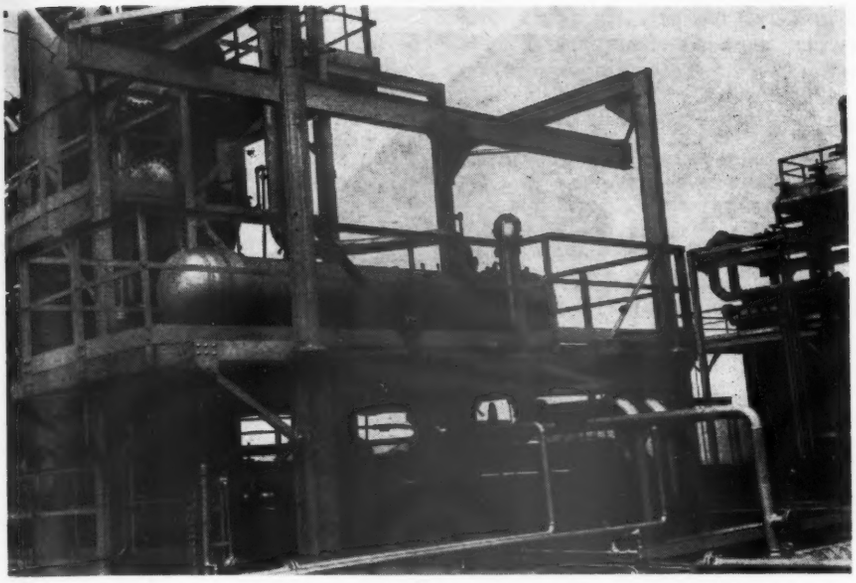


FIG. 1. Overhead condenser in a large eastern refinery equipped with Duplex tubing—steel inside, Admiralty outside.

Duplex Tubing for Use in the Petroleum Industry

C. L. BULOW*

One of the most troublesome corrosion problems encountered in the petroleum industry is one where heat exchanger and condenser tubing is attacked simultaneously inside and outside by 2 entirely different types of corrosive media. It is often possible to find a metal or alloy that has satisfactory corrosion resistance towards each corrosive medium. A suitable combination of metals or alloys can be selected that will stand up satisfactorily when combined in the form of a duplex tube. One metal or alloy will resist the outside corrosive conditions, the other will resist inside corrosive conditions. Obviously, duplex tubing is finding wider usage as a solution to dual corrosion problems. Duplex tubes are put together by sliding one seamless tube inside the other and then drawing the tubes together to obtain a tight friction grip or mechanical bond between them. Although there are other ways of making duplex tubing, up to the present time, this has been the most economical way of preparing such a tube.

*Corrosion metallurgist, Bridgeport Brass Company, Bridgeport, Connecticut.

One of the most frequently asked questions regarding a duplex tube is "What are the heat transfer characteristics of a mechanically bonded duplex tube?" Numerous heat transfer experiments have revealed that drawn duplex tubes made by the procedure described above consisting of a combination of copper or copper alloys with ferrous materials usually show heat transfer rates between the copper or copper alloy (high heat transfer rate) and the ferrous alloy (lower heat transfer rate) or approaching or equal to the copper alloy.

Other tests have been carried out to determine the heat transfer characteristics of the mechanical bond existing in duplex tubes. Two steel tubes were drawn together in the same manner as used for duplex tubing. This double-wall steel tube was compared with a single-wall steel tube of the same dimensions. Heat transfer tests showed that the mechanically bonded duplex tubes gave identically the same heat transfer rate. Another test was conducted comparing double-wall copper with single-wall copper of the same dimensions and, here again, identically the same heat transfer values were obtained (Table 1).

The heat transfer data indicate that appreciably smaller size heat exchangers should be feasible with duplex tubing as compared with larger size units built of single wall steel tubing. Where steel tubes have been replaced with steel-copper alloy duplex tubes the greater heat transfer rates and corrosion resistance have resulted in a reduction of power and maintenance costs. Some companies that have replaced corroding steel tubes in ammonia condensers with steel/copper duplex tubes have reported as much as 20 to 25 per cent reduction in power costs, as one of the tangible returns. The reduction of corrosion and slime has markedly reduced the frequency of tube cleanings.

Selection of Proper Gage

The large number of chemicals and processes used in the petroleum industry present many corrosion problems in condensers and heat exchangers where duplex tubing already has helped to reduce maintenance costs and increase the service life of tube bundles. Sometimes it is possible to estimate from existing plant records covering various materials what the service life of aluminum, nickel, stainless steel, low carbon steel, or ferrous alloy of a certain gage would be on the product side and what the service life of a certain gage of copper or copper alloy would be from the cooling water side. Where the rates of corrosion on the product side and the cooling side have been established, it is possible to calculate the proper gages of the two components to use in a duplex tube. Where such information is available, the most economical tube is designed of such gages of the two components that perforation of both components would occur at approximately the same time. This often results in the

TABLE 1

Results of heat transfer tests duplex vs single wall tubing. Steam condensed on outside surface with fresh water passing through the tubes.

Water velocity feet per second	Overall heat transfer rate at indicated water velocity Btu/hr/sq ft/° F	
	Duplex tubing ¾ in OD x Wall Thicknesses .0325 in. and .0325 in. Steel to Steel	Regular tubing ¾ in. OD x Wall Thickness .065 in. Steel
2½	371	380
3½	458	458
	Copper to Copper	Copper
2½	580	600
3½	750	740
	Steel to Copper	Steel
2½	465	380
3½	625	458

EXCLUSIVE

use of a much thinner total gage duplex tube than normally would be used with a single-wall tube. The use of steel-copper duplex tubes instead of straight copper or copper alloy tubing has saved from 50 to 80 per cent copper.

Uses of Duplex Tubes

One refinery formerly using steel or red brass tubing for cooling propane gas containing an appreciable amount of hydrogen sulfide and some ammonia added to neutralize acidic constituents found it necessary to retube the heat exchangers every one or two years due to failure on the river water side. These gases entered the heat exchanger at a temperature of about 120 F. Replacement of the straight steel or red brass tubes with 1-in. OD duplex tubes by .083-in. low carbon steel lined with .032-in. red brass resulted in an average life ranging from 6 to 10 years.

A similar exception, involving longer chain hydrocarbons containing a higher concentration of hydrogen sulfide and ammonia as an acid neutralizer was improved considerably a number of years ago through the use of the same type of duplex tubing. In these heat exchangers the gas entered the equipment at about 200 F. The temperature range was considered low enough to use a low carbon steel tube lined with Red Brass. In this and the next stage of cooling, where the gases enter at 120 F, duplex tubes of the same composition have proved equally beneficial.

Another application which has been in use for some time, dealt with the handling of 90 to 95 per cent hydrogen sulfide containing water and traces of other substances. This gas comes from a caustic boiler used in the regeneration of caustic liquor that has been used to strip hydrogen sulfide and other materials from a stream of hydrocarbon gases. This application over a period of time should prove equally successful as it is known that the low carbon steel has performed in a satisfactory manner handling these gases, although it has been failing from corrosion by the water used for cooling.

On rare occasions, mercury may be introduced into the stream of hydrocarbon gases, either from the crude or due to contamination from equipment containing mercury. Liquid mercury may be deposited on the cool surface of copper alloy tubing and may penetrate the metal along the grain boundaries. Duplex tubing with steel to the mercury laden gas side and copper base alloy to the water side, is a solution to the problem. This is based on wide, successful use of steel with liquid and gaseous mercury.

In addition to handling petroleum products containing ammonia, and hydrogen sulfide, etc., steel combined with copper has found fairly extensive application in the construction of fuel oil heaters, particularly in double bundle leak-proof designs.

Aluminum/copper alloy duplex tubes are finding increased application in lubricating oil coolers used either in manufacturing lubricating oils or in water cooling of certain lubricating oils from turbines, motors, etc. Where it is necessary to conserve copper it is likely that this duplex tube will find increased use.

In some services, the stainless steels have shown excellent corrosion resistance toward the various gases and solutions encountered in the petroleum industry. In some instances, however, stainless steel tubes have failed from transcrystalline stress corrosion cracking in contact with certain cooling waters (see Fig. 2). Where stress corrosion cracking of stainless steel has occurred from the outside in atmospheric coolers, copper alloy clad stainless steel tubes have been used. In applications of this type, thin gages of stainless steel 0.035 in. or thinner have usually been used. Stainless steel clad copper tubes are being used to withstand corrosion by impinging high velocity vapors.

In the presence of many nitrogen compounds, such as ammonia, monoethanolamine and other amines, organic cyanides, etc., stainless steel and low carbon steel shows good to excellent corrosion resistance. In a number of plants handling these materials, low carbon steel has shown good to excellent corrosion resistance, except where cooling water or steam came into contact with the steel. The lining or cladding of the steel surface exposed to fresh or salt cooling waters has resulted in a marked improvement in tube life due to the excellent corrosion resistance on both surfaces.

In coolers handling various types of amines and mixtures containing amines, low carbon steel lined with such materials as Admiralty and various cupro nickel alloys and aluminum brass have performed in a very satisfactory manner. Improvement has been particularly noticeable where gulf or bay waters are used for cooling.

Duplex tubing is doing an outstanding job in the field of ammonia refrigeration or cooling and in equipment used for the manufacture of ammonia. (See Fig. 3.) Here the problem is one of handling two entirely different types of corrosive agents—ammonia (gas or liquid) and various cooling waters. Although low carbon steel shows excellent corrosive resistance toward ammonia, it is rapidly corroded by cooling waters and is quickly covered with rust and slime. On the other hand, copper and its alloys that resist corrosion from cooling waters, are often very vulnerable to attack by ammonia. Duplex tubing with steel to the ammonia side and copper, or one of its alloys, to the water or brine side is a logical combination and is far outlasting straight steel tubing for such applications. For services of this type steel/copper duplex tubing is the most popular, but Admiralty and red brass are increasing for use on the fresh water side. 70/30 Cupro nickel, 80/20 Cupro

FIG. 2. Stress corrosion cracking in 18-8 stainless steel.

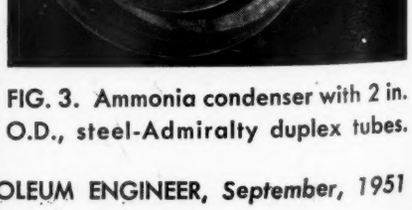


FIG. 3. Ammonia condenser with 2 in. O.D., steel-Admiralty duplex tubes.

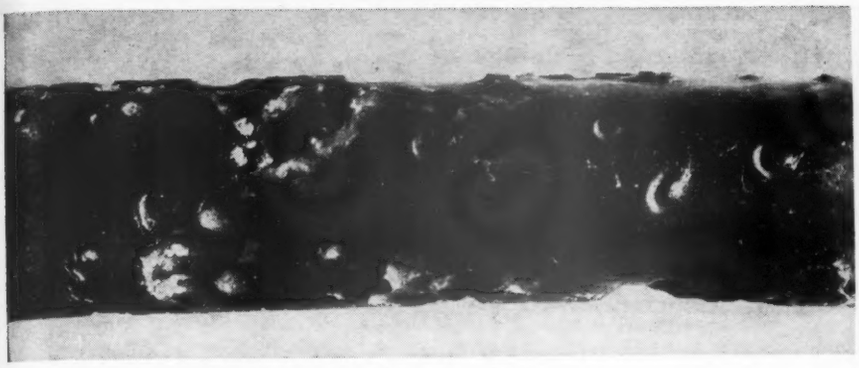


FIG. 4. Vapor impingement corrosion near gas outlet on outside surface of admiralty tubing.

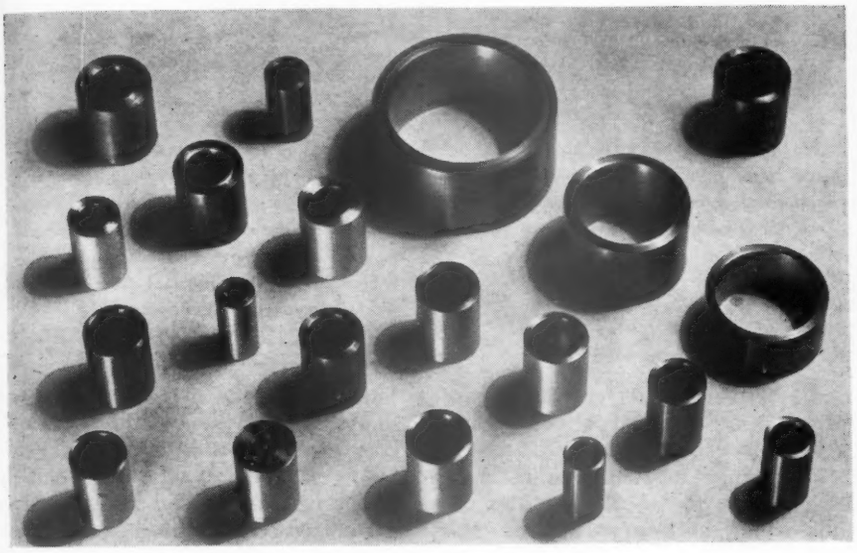
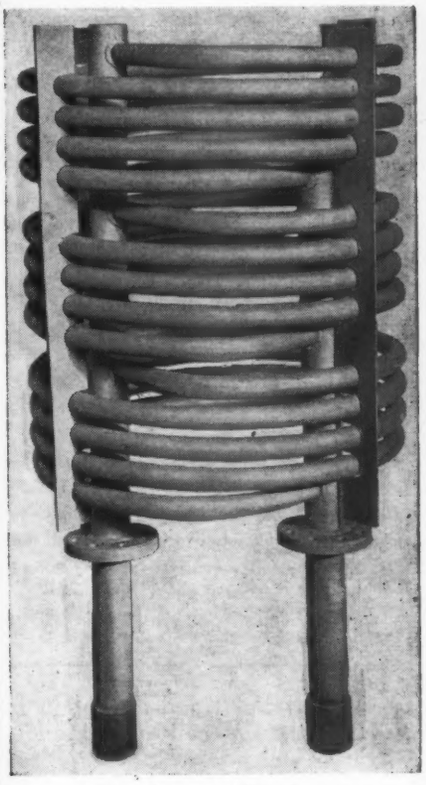


FIG. 6. Duplex tubing in different diameters, materials, and wall thicknesses.

FIG. 5. High pressure coil—stainless steel.



Courtesy Patterson-Kelley Company

nickel, aluminum brass, aluminum bronze and Admiralty brass are usually combined with steel where sea water is used for cooling ammonia.

Inter and after coolers handling various compressed gases, often present a dual corrosion problem that cannot readily be handled by a single-wall tube. One such problem studied a number of years ago, showed that impinging gases such coolers lead to severe thinning at the entrance ends of the tubes which gradually diminished over a distance of about 12 to 18 in. The .083-in. wall copper tubes originally used lasted less than two years. Replacement with .055-in. copper/.035-in. 3S aluminum greatly increased the life of the tubes in this service. After two years exposure, there was scarcely any corrosion detected on the aluminum surfaces of these duplex tubes.

The usable temperature range of aluminum can be increased by using duplex tubing made up of aluminum with copper, copper alloys, or steel.

Duplex tubing is finding increasing use in condensers, heat exchangers, and coolers for handling numerous corrosive gases where the general corrosion resistance or impingement corrosion resistance of low carbon steel, chrome steel, stainless steel, tin, Monel metal, aluminum, nickel, and lead combined with copper alloys, etc., are required. (See Fig. 4.)

One of the most corrosive liquids widely used in various types of processing is sulfuric acid. Aside from lead, no other commercial metal can withstand sulfuric acid under a wide range of conditions for any appreciable length of time. Steam heating and cooling coils immersed in sulfuric acid solution also are generally made from lead.

Installations of coils made from lead/copper duplex tubing have shown some important advantages over lead tubing. The stronger, harder, inner tube of copper or copper alloy permits the use of higher steam temperatures and pressures than are practical with the softer and weaker lead tubing, thus the usual range of temperature and pressure is increased substantially. Furthermore, copper stands the effects of corrosive steam better than lead.

Lead/copper duplex tubing may be used at steam pressures up to 150 psi, 360 F, where lead tubing is limited to a maximum pressure of about 50 lb at 300 F.

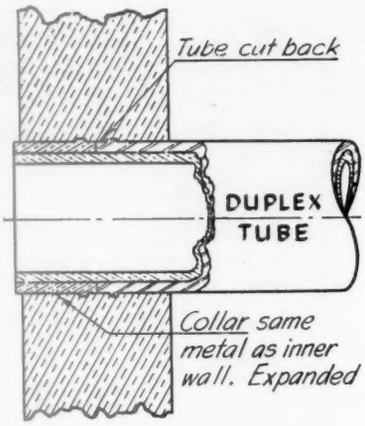
The corrosion resistance of lead is generally excellent in sulfuric acid solutions containing up to 50 per cent acid. Lead is also resistant to sulfurous, phosphoric, and chromic acids, all of which can be heated or cooled by immersion of lead/copper duplex heating coils. Lead is also satisfactory for resisting corrosion by wet or dry sulfur dioxide and sulfur trioxide.

The thickness of the lead component of a lead/copper duplex tube is usually about $\frac{1}{8}$ in. or more, depending upon the requirements.

Duplex tubing can be made of several grades of lead to meet ASTM specifications. Through the use of high purity lead, maximum corrosion resistance can be obtained. The high purity leads (chemical) are useful up to about 400 F. Antimonial leads, because of their lower melting points, are limited to a maximum of about 250 F.

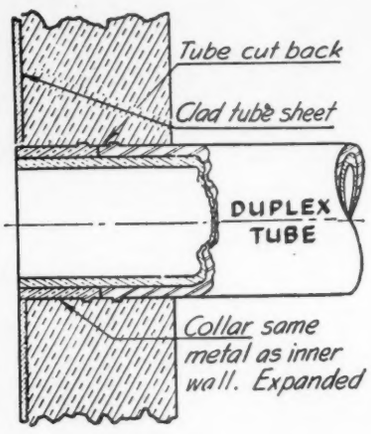
In making heating coils from duplex tubing, it may be necessary to

FIG. 7. Preventing galvanic corrosion—low and medium pressures.



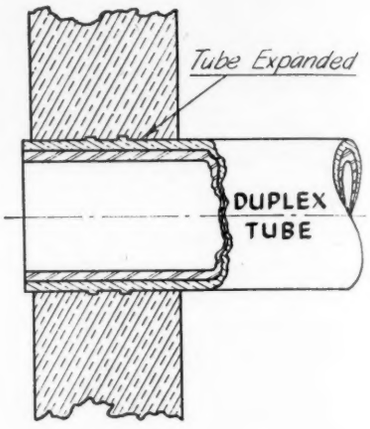
Where it is necessary to prevent galvanic action at the tube sheet, a ferrule of the same composition as the inside of the duplex tube, and similar to the tube sheet is used. This involves cutting back a section of the outside member of the duplex tube.

FIG. 8. Protecting both tube and tube sheet from galvanic corrosion.



When the liquid or gas passing through the tubes attacks the tube sheet, the latter is protected by covering it with the same metal as used for the inside member of the duplex tube.

FIG. 9. Tube expanded—high and low liquid velocities.



Plain expansion is used on both the inlet and outlet ends where high pressure and low liquid velocities through the tube are involved. This method is used successfully where steel-copper duplex tubes are rolled in steel tube sheets when exposed to fresh water.

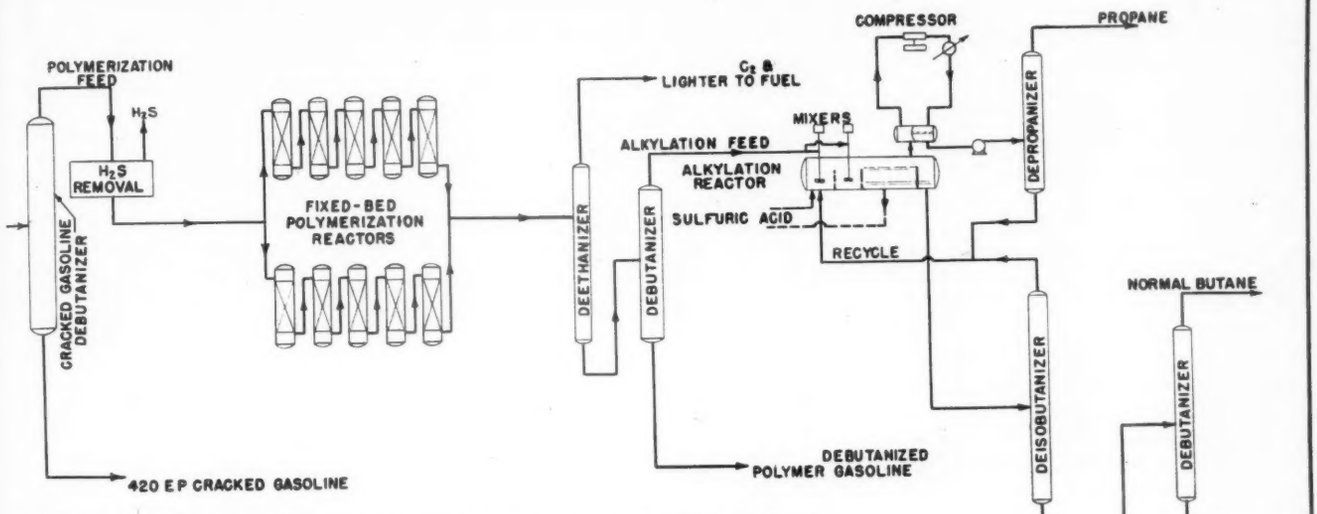
join two or more lengths to obtain the required sizes of coils (see Fig. 5). Joints are made by cutting back the outer lead component about ½ in. from each end of the duplex tubes to be connected. The copper inner tube from one end is expanded by driving in a plug of the proper size so that the expanded end becomes large enough to receive the copper inner tube of the other length of duplex. The joint is then secured by soldering. A thick overlay of pure lead is wiped on to cover the exposed copper. In shell and tube type construction, several types of rubber grommets have been used to fasten the tubes in the tube sheets. After prolonged service, lead/copper duplex tubing coils possess excellent heat transfer characteristics and exhibit superior corrosion resistance.

One of the chief drawbacks to the use of duplex tubing originally occurred when no steps were taken to prevent galvanic corrosion where the tubes were expanded into tube sheets. This problem has been overcome by cutting back the outside component of the duplex tube and replacing this section with a ferrule of the same composition as the inside component (see Figs. 7 and 8). The length of the cutback and the ferrule has varied from one-fifth to one-half the thickness of the tube sheet. The ferrule used to cover the cutback portion of the duplex tube has the same thickness as the outside member. This type of ferruled duplex tubing has been used where salt water and other corrosives have passed through the tubes. Where fresh water, etc., passes through copper and copper alloy lined duplex tubes the use of ferrules usually is not necessary (see Fig. 9). Duplex tubes have in certain heat exchangers been welded, brazed, or soldered to the tube sheets. This practice is usually followed in equipment that must be leakproof at moderate to high pressure.

Duplex tubes for heat exchanger applications are made primarily of tubing that before bonding complies with standard condenser tube specifications. Because of the bonding method, duplex tubes, obviously cannot always comply as regards hardness with the original specifications covering the tubing used. The hardness of one or both of the components of the duplex tube usually is increased through the work-hardening taking place during the drawing of the tube. For this reason, certain combinations of duplex tubes may be difficult to roll-in or expand into tube sheets that are softer than the tubes. This is influenced further by the: Tube sheet dimensions, tube hole layout, ligament spacing, tube sizes, clearance between tube and tube sheet hole, rolling practice, condition of the surface of the tube sheet hole, and smoothness on the tube surface. These factors are not peculiar to duplex tubes, but will be recognized as generally applying to condenser heat exchanger and boiler tubes, particularly to harder tubes where the hardness is due to cold working or alloying. Where the hardness of steel clad duplex tubes needs to be reduced below hardness of tube sheet, the duplex tubes may be end-annealed. Over a hundred combinations of metals are available at the present time. Many of these are available only in the mechanically bonded type of duplex tube. The most popular combinations have been made from the following metals and alloys:

Admiralty
Aluminum brass
Copper
Cupro nickel (various grades)
5 per cent aluminum bronze (Duronze 4)
Muntz metal
Red brass
Yellow brass
Naval brass
Silicon bronze
Aluminum
Lead
Monel metal
Nickel
Steel (low carbon)
Alloy steels
Stainless steel
Tin

Even in the comparatively short time that duplex tubes have been available, they have found wide application in the process and refining industries. When the proper combinations are used, savings can be realized in: extending tube life, reducing maintenance, fewer shut downs, and conserving critical materials. * * *



Method used in processing cracked gasoline blend to effectively raise its octane value and also supply a balanced output of liquefied gases for rural use.

INTEGRATED PROCESSING

Keynote of a Modern Refinery

Careful balancing of all streams in the refinery make for uniform and carefully controlled product qualities

W. T. ZIEGENHAIN

A MOST closely inter-related and well correlated refinery processing operation is maintained by the Mid-Continent Petroleum Corporation at its large plant in Tulsa, Oklahoma. Adequate utilization of each effluent stream in further up-grading, an interdependence of each unit on other units, results in exceptional product distribution from each barrel of crude.

Heart of the light-oil processing is the Fluid catalytic cracking unit, operating on natural catalyst and receiving feedstock from three main sources in the refinery. These include virgin gas oil from three crude fractionating units, gas oil from the Vis-breaker operating on vacuum reduced crude, and heavy naphthenic extract discharged from the solvent lube-oil treating units. Cat-cracker feedstock requirements, both as to quantity and coke deposition are exactly balanced by these three gas oil sources. Thus, the crude bottoms and the naphthenic extracts, which are usually routed to low-grade fuel oil, are up-graded to valuable gasoline components with an accompanying minimum production of over-all refinery fuel oil.

A catalytic polymerization unit has as its main purpose the conversion of propylene and part of the butylenes into high octane, low vapor pressure gasoline components. The poly plant not only saves hydrocarbons that would otherwise be burned as fuel gas, but, in effect, becomes an excellent feedstock preparation unit for the alkylation plant. The poly plant converts most of the propylene, all of the isobutylene, all of the butene-1, but very little of the butene-2 into poly gasoline. Butene-2 is the most desirable of the unsaturated hydrocarbons for alkylation feedstock along with the isobutane. By proper and closely controlled temperatures and pressures in the cat-poly reactors, sufficient unsaturated hydrocarbons are excluded from the poly plant to balance, mol for mol, the isobutane leaving the poly plant, thus making a perfect feed for the alkylation plant.

The particular duty of the sulfuric alkylation unit is, the removal of high vapor pressure iso-butane from the refinery gasoline pool, converting it from a 72 lb RVP material, to a 3 lb RVP gasoline, which has a relatively high TEL susceptibility. This step makes possible the inclusion of considerable quantities of natural gasoline into the refinery gasoline, a procedure that is economically advantageous. By charging primarily butene-2, and maintaining a high acid strength and recycle iso-butane ratio, an exceptionally high octane alkylate is obtained, being in the order of 95.0

EXCLUSIVE

—Research clear. Here again, the economical feasibility of operating with a high acid strength is made possible by the inter-relating of one unit with another.

Mid-Continent has found that spent alkylation acid can be used very successfully to acid-treat bright-stock lube oil, in propane solution, for color, stability, and carbon residue. Acid requirements for this purpose are balanced conveniently by the acid rejected at the alkylation unit. Flexibility is available for changes in acid consumption by merely changing slightly the strength of the acid leaving the alkylation unit, to balance the amount required for brightstock treating. Also the propane used for propane de-asphaltizing ahead of the acid treating in propane solution, comes from the alkylation unit, thus gaining full effect from inter-related processing.

A further tie-up between units exists in the case of a thermal cracking unit, fed by heavy cat-cycle gas oil and decanted oil from the catcracker. High temperature, low crack-per-pass operation results in very favorable yields of gasoline from otherwise low-grade cycle stocks.

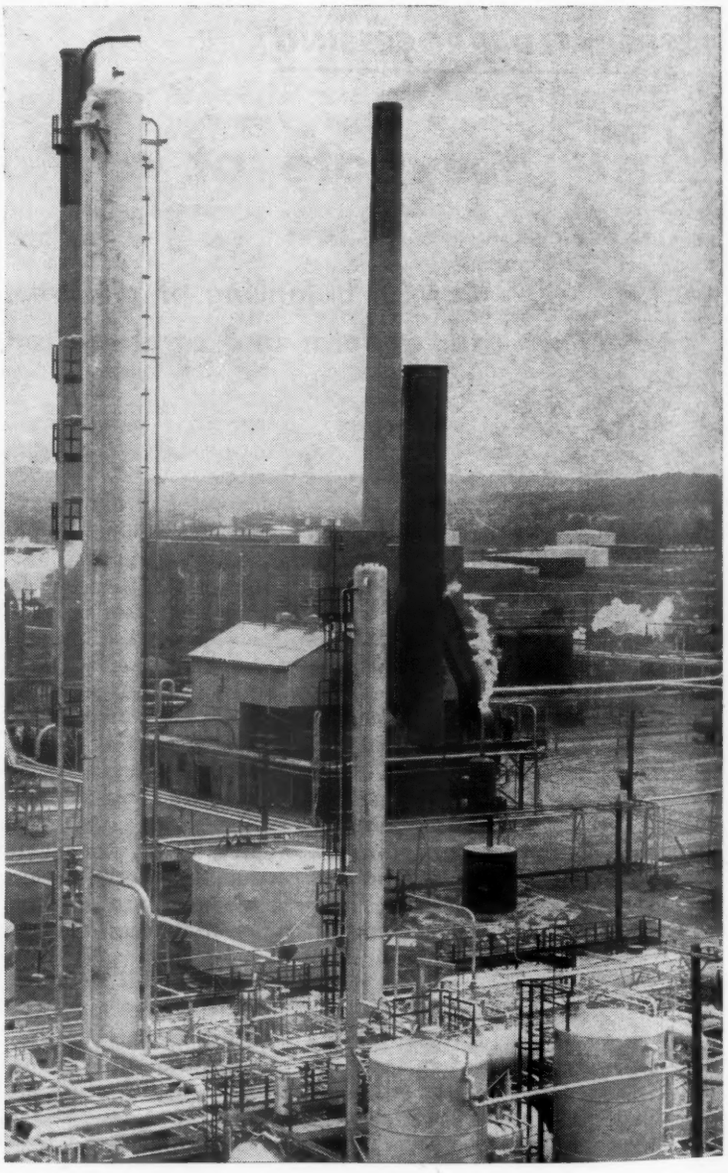
From the thermal cracking unit a very refractory cycle sidestream product, the least valuable of any gas oil in the refinery, is used for fuel oil blending and acid sludge dilution at the de-asphaltizing and acid treating unit.

Thus a pattern of diverting the several streams to their most advantageous use in other units, before blending and storage has resulted not only in low operating costs, but also in high quality products. A few more details as to yield percentages and procedures may be of interest.

The use of natural catalyst rather than synthetic in the cat-cracker conforms with the general program of producing low vapor pressure gasoline, so that outside natural gasoline may be absorbed. The debutanized cat cracked gasoline has a vapor pressure of about 4.5 lb RVP, whereas the same gasoline produced with synthetic catalyst would have a vapor pressure of about 6.5 lb RVP.

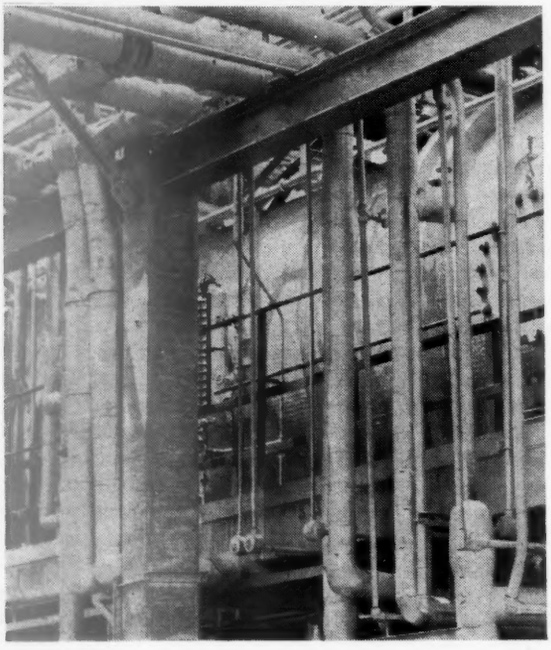
The vis-breaker operation is of particular interest. Long runs, as high as 70 days are unique in this type of operation, where a 14 gravity, high carbon residuum (14.0 per cent) feed is charged. A coil diluent (water) is a material factor in this operation, coupled wtih a vacuum tower for high recovery of gas oil produced in the mild cracking operation. Yields of gas oil average about 50 per cent, gasoline 15 per cent, with the balance being fuel oil and gas.

The normal daily charge to the catpoly plant is the overhead stream from a well-fractionated, light hydrocarbon blend. This comes from the cat-cracker, thermal reformer when operating, vis-breaker, and thermal cracking unit. These combined high pressure distillates are fractionated into debutanized cracked gasoline and overhead material charge to the poly reactors through H_2S removal equipment. The composition of this charge to the 34-tray debutanizer is as follows:



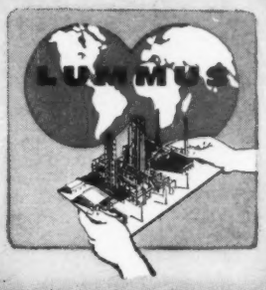
Sulfuric acid alkylation unit. Behind two vertical acid storage drums shown in foreground is alkylation reactor. The latter includes a horizontal 10-ft drum 30 ft long.

Almost enclosed by supporting members and transfer lines is alkylation reactor. Note curved, reinforcing suspension supports for flow-directional plates inside.



Think of this sign first . . . . . for **Ethylene**

Manufacturing Facilities



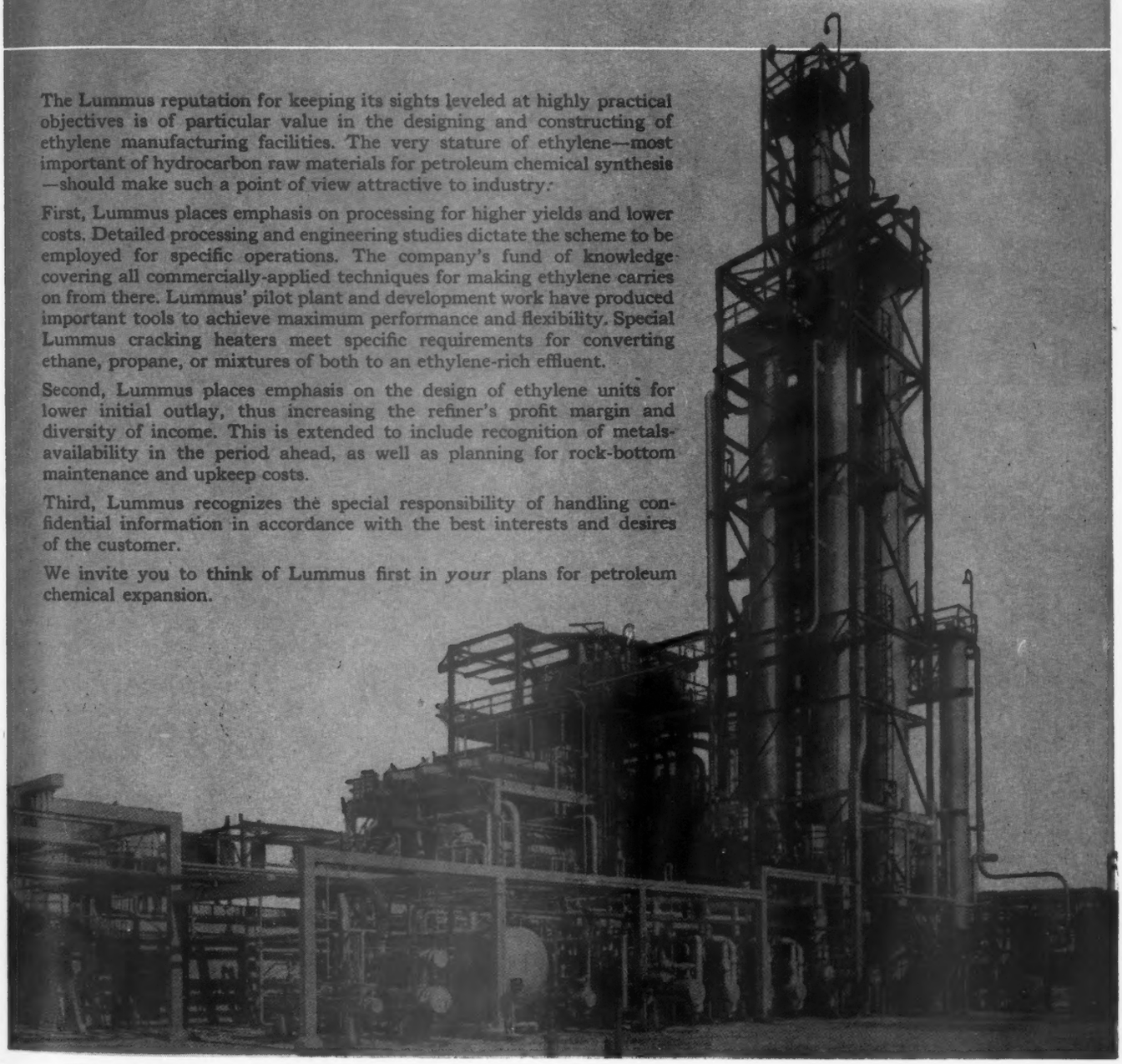
The Lummus reputation for keeping its sights leveled at highly practical objectives is of particular value in the designing and constructing of ethylene manufacturing facilities. The very stature of ethylene—most important of hydrocarbon raw materials for petroleum chemical synthesis—should make such a point of view attractive to industry.

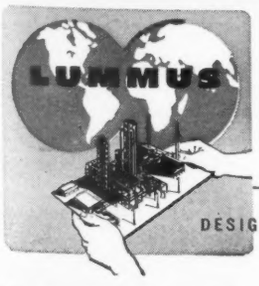
First, Lummus places emphasis on processing for higher yields and lower costs. Detailed processing and engineering studies dictate the scheme to be employed for specific operations. The company's fund of knowledge covering all commercially-applied techniques for making ethylene carries on from there. Lummus' pilot plant and development work have produced important tools to achieve maximum performance and flexibility. Special Lummus cracking heaters meet specific requirements for converting ethane, propane, or mixtures of both to an ethylene-rich effluent.

Second, Lummus places emphasis on the design of ethylene units for lower initial outlay, thus increasing the refiner's profit margin and diversity of income. This is extended to include recognition of metals-availability in the period ahead, as well as planning for rock-bottom maintenance and upkeep costs.

Third, Lummus recognizes the special responsibility of handling confidential information in accordance with the best interests and desires of the customer.

We invite you to think of Lummus first in *your* plans for petroleum chemical expansion.





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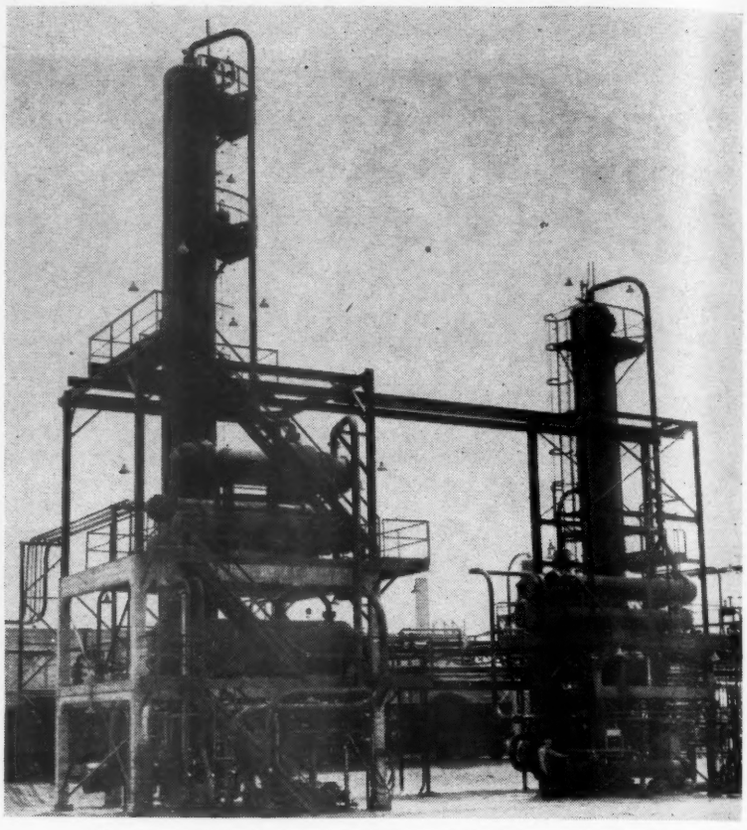
DESIGNING ENGINEERS AND CONSTRUCTORS FOR THE PETROLEUM AND CHEMICAL INDUSTRIES

Cracked gasoline stabilizer, right; TPP H_2S removal unit, foreground; poly-debutanizer, left.



Tower on left is deethanizer and that on right, beside which the operator is standing, is alkylate debutanizer.

	Liquid volume percentage
Methane	0.3
Ethene	0.4
Ethane	2.1
Propene	4.1
Propane	5.1
Isobutane	3.4
Normal butane	4.2
C_4 Olefins	6.3
C_5 and Heavier (420EP)	74.1
	100.0

A typical sample of debutanized gasoline would have the following characteristics:

ASTM Distillation	
IP	106 F
20 per cent	175
50	278
90	378
EP	420
Octane	84 (R-clear)
Gravity	55 deg

The composition of the charge of the 10-case non-selective type poly reactors is:

	Liquid volume percentage
Methane	1.2
Ethene	1.6
Ethane	7.8
Propene	15.6
Propane	19.1
Isobutane	12.7
Normal Butane	15.7
C_4 Olefins	24.1
Pentanes	2.2
	100.0

The reactor effluent stream is first directed through a deethanizer wherein the C_2 and lighter hydrocarbons are removed to fuel gas. The deethanizer bottoms are directed to the poly debutanizer, which separates overhead alkylation charge and produces low RVP poly gasoline out the bottom. Laboratory data show:

Gravity	61 deg
IP	157 F
20 per cent	215
50	247
90	357
EP	436
VP	2
Octane	96

In the alkylation plant the consumption of fresh 98 per cent acid amounts to approximately 1.0 lb per bbl of true alkylate, when discharged at 94-95 per cent strength. As the acid is reused for lube oil treating, the actual acid charge against the alkylation unit is negligible, resulting in a low operating cost.

A depropanizer tower in the alkylation unit is charged with light hydrocarbon auto-refrigerant from the reactor, yielding an overhead LPG propane product of approximately 33 per cent of the alkylation charge. The alkylation plant deisobutanizer fractionates recycle isobutane overhead for return to the reactor, and removes n-butane and alkylate from the bottom. This butane-alkylate mixture may be further fractionated to separate the n-butane for summer time storage or the mixture may go directly to premium grade motor gasoline. In this manner the refinery is provided a means for modifying its operations sufficiently to meet changing seasonal demands in its motor fuel. Although refiners generally recognize the importance of balanced gasoline for the purpose of starting ease, normally not so much stress is placed upon its changing seasonal composition. The primary product taken from this alkylation unit comprises approximately 33 per cent of the alkylation unit charge, and this alkylate gasoline has the following typical distillation:

IP	132 F
20 per cent	201
50	222
90	302
EP	398

Other laboratory data on a typical sample would show it to have the following characteristics:

Gravity	68.5 deg
VP	3.2 lb
Octane	94.8 (R-clear)

Present studies include the feasibility of replacing existing thermal reforming with catalytic reforming for even further increasing the octane value of the straightrun gasoline.

* * *

Mechanical Seals for Centrifugal Pumps

Mechanical seals eventually may replace completely the packing used formerly on majority of centrifugal pumps

D. R. RANKIN*

RESTRICTING leakage around the rotating shafts of centrifugal pumps has been a major nightmare for design engineers and refinery operators since the centrifugal pump was first introduced into refinery service. Much has been done to improve the design of stuffing boxes, the materials used in packing, and in the techniques involved in the refinery to reduce these problems. With new solutions, however, have come new problems in the increased amount of lighter fraction materials handled in refineries and gasoline plants. For many years efforts have been made to develop successful means of replacing packing with mechanical-type sealing elements. In some plants discouraging experiences have resulted from the use of mechanical seals and they are, for the time being, banned even from the thinking of operators and engineers in charge. In other areas, an increasing number of mechanical seals are being used with increasing success. As is true of almost all newer methods, many of the failures are the result of operators and engineers who do not understand the problems of the new device as well as the equipment they have used since their apprenticeship. A greater understanding of the problems and characteristics of mechanical seals should be helpful, both to those operators who now think they are the answer to many of their problems and to those who have had such adverse experiences that they will not allow them within their refinery area.

It is highly probable that mechanical seals will completely replace packing on the majority of centrifugal pumps in the ultimate future.

Mechanical seals are now operating satisfactorily in many operations where packing has never been satisfactory. Pumps handling light fractions that frequently looked as if the next ice age were here due to frosting of the stuffing box area from evaporative cooling of leaking liquids now operate smoothly with no indication of appreciable loss of light material handled. Units pumping slurries that would wear out packing within a week will run for months before requiring replacement of seal faces with abrasive resistant seal designs. Processes where extremely high suction pressures require throttle bushings and bleed-back lines representing appreciable loss of the product back to the low pressure containers have been equipped with balanced seals that successfully work week in and week out.

In a field very different from process industries where cost is a prime consideration and operation experience is nil, mechanical seals have replaced packing on thousands of domestic water system pumps. The high volume domestic water pumps built with mechanical shaft seals instead of packing have brought the price of seals down so these pumps require no premium in price to obtain a mechanical seal that is doing a superior job to that done by packing.

If seals can solve the toughest jobs and also be used on the cheapest types of pumps sold in great volume, there is every reason to believe that as time passes, pumps between these two extremes will be built specifically for mechanical seals and packing will become a thing of the past.

It is frankly admitted that at present there is no satisfactory mechanical seal for refinery services where temperatures of the seal exceed 450 F. All successful mechanical seals have resilient components made from a variety of synthetic materials, with unique properties as required for the service. Normal low cost oil resistant synthetics cannot be used for continuous operation in excess of 250 F, and it is necessary to go to such materials as Teflon and Kel-F for temperatures approaching 450 F. Devices have been arranged to maintain the fluid next to the seals below these critical temperatures by cooling the fluid adjacent to the seal so liquids appreciably above the maximum temperature can be pumped. There is nothing definitely in sight today indicating that seals will be available for temperatures above 450 F, which leaves an important gap uncovered by mechanical seals at present. Projecting the rapid progress that has been made on synthetic materials over the past 10 years, however, it is reasonable to assume that resilient materials may be developed for use in temperatures up to 800 to 850 degrees in the near future. It is also possible that seal designs that eliminate the critical resilient elements will be developed, but none are offered commercially today.

A seal is very much like the little girl who had the curl down the middle of her forehead—"When they are good they are very very good, but when they are bad they are horrid." It is principally for this reason that seals have not gained wider acceptance in refineries to date. If a seal ring cracks, leakage can be much greater than would develop from worn packing and no warning of failure is given.

It is also not uncommon to take a pump off the line; rework the seal; put it back in service, only to find that the seal was improperly assembled and the whole process must be repeated. If, in trying seals for the first time, the operator has such an experience, he may very well rule out seals from his refinery area. On the other hand, if he has good experience with the first seals and is able to lick a job that had to be packed every few days by replacing it with seals requiring service only every six months, then he thinks very differently about seals. Very few operators who have used seals extensively have not had some trouble getting them going initially. If the backlog of their experience indicates to them that once the seal is operating it normally will go a long time before maintenance is required, however, they are perfectly willing to accept the occasional idiosyncrasies of this type of mechanical shaft sealing device. As maintenance men become more experienced in handling them and understand them better, seals are doing a better job and becoming more widely accepted.

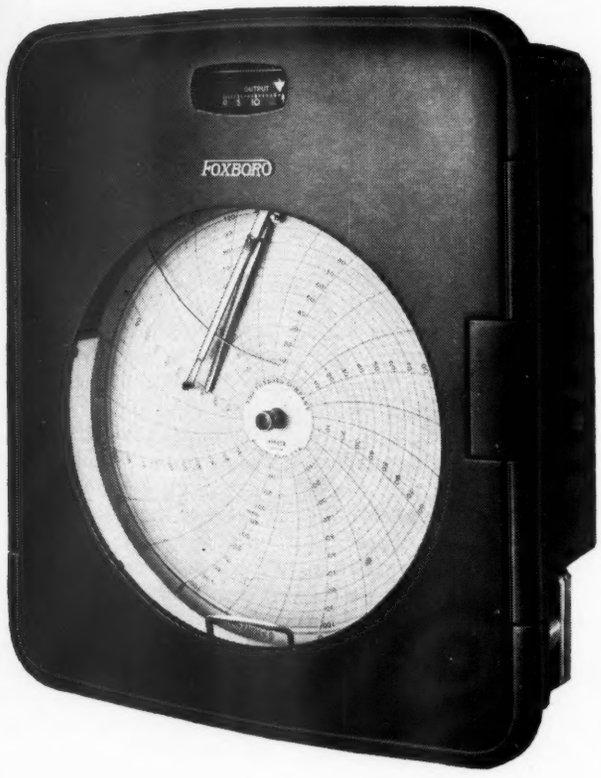
Realizing that one of the big problems in a process plant is to get a pump back on the line if a seal fails, some manufacturers have built up seals in cartridge form that permit them to be checked on test prior to installation on the pump. When this is done, the critical lapped wearing faces and "O" ring resilient elements do not need to be disturbed when installing the seal on

*Chief engineer, Peerless Pump Division, Food Machinery and Chemical Corporation.

EXCLUSIVE

better measurement and control of

LIQUID LEVEL



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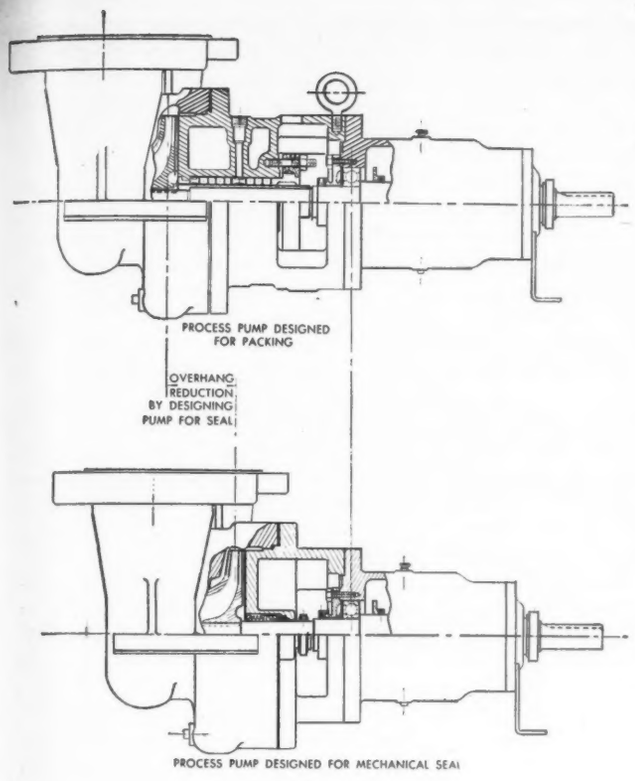
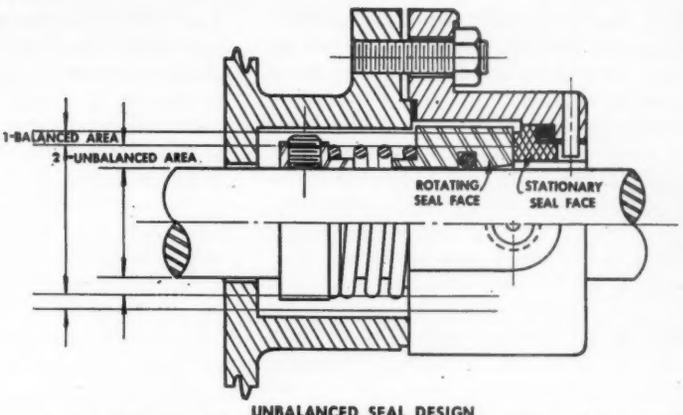
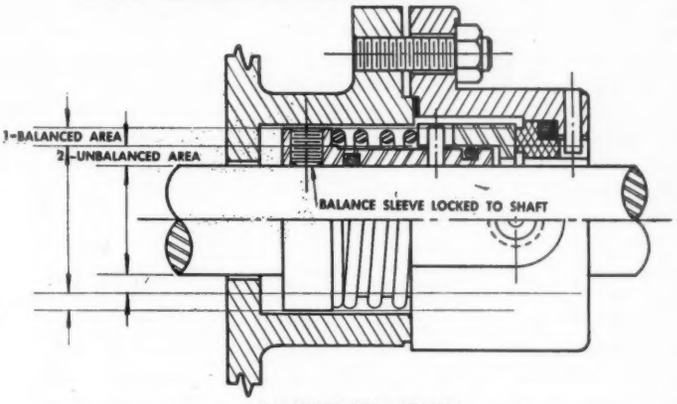

PROCESS PUMP DESIGNED FOR PACKING
OVERHANG REDUCTION BY DESIGNING PUMP FOR SEAL
PROCESS PUMP DESIGNED FOR MECHANICAL SEAL

FIG. 1



UNBALANCED SEAL DESIGN

1. Forces resulting from stuffing box pressure applied over *balanced area* equal to pressure forces tending to separate seal faces.
2. Forces resulting from stuffing box pressure applied over *unbalanced area* carried by seal faces acting as thrust bearing.



BALANCED SEAL DESIGN

1. Forces resulting from stuffing box pressure applied over *balanced area* equal to pressure forces tending to separate seal faces.
2. Forces resulting from stuffing box pressure applied to *balance sleeve* which transmits force through shaft to pump thrust bearings.

FIG. 2

the pumping unit. The only joints that have to be made are between the sleeve and the shaft and between the flange and the pump housing so that there is normally very little chance of the seal not working when it is put into the line if it has not been tampered with prior to installing.

As mechanical seals prove themselves in various applications, more pumps are designed specifically for use with them. A pump designed specifically for use with a seal is a better machine than a pump designed for packing with a seal added later. As seal face rings must be installed over the end of the shaft it is not possible to work on a seal without removing the pump impeller. Thus, the working area behind the packing container and the bearing of the pump is not required when seals are used. The length of a mechanical seal is normally appreciably less than that of packing. Thus, a pump designed specifically for a seal has the impeller much closer to the pump bearing, greatly reducing the shaft deflection due to runout or side forces developed by hydraulic thrust on impeller. (Fig. 1).

It is also less expensive to manufacture a pump specifically for a seal than to make a pump for packing and later adapt it for a seal usage. Thus, it is highly desirable to purchase a pump which is specifically designed for seals rather than merely adapt seals to existing designs.

During its infancy many dubious companies specified seals on pumps with the units so constructed that packing can be used in case the seal does not operate properly. This type of procedure is definitely one of straddling the fence so that the seal is not given every opportunity to succeed. If the engineers and operators cannot convince themselves that the seal is correct for the application, then it would be better to specify packing and forget seals. If a seal is indicated, it should be given every chance by having the pump correctly designed for the best possible seal. Frequently, a well-designed balanced seal will require more radial space than conventional packing but will not require as much depth. Thus, it is often desirable to bore out the packing box or machine it off to permit a satisfactory installation. This cannot be done if the original packing dimensions are maintained. Frequently, an unbalanced seal is installed in an existing pump where a balanced seal would do a better job in order not to upset the possible use of packing in the future. This is poor long-term economy.

In purchasing a pump with a mechanical seal it is just as important to see that the pump construction is such that it is easy to replace the seal as it was in purchasing a stuffing box type pump to see that there was ample room to get in around the shaft and add more rings of packing or to repack the pump. On some pumps it is possible to get at the seal by simply removing an end plate and the impeller. On general service refinery pumps the rotating element can be removed without disturbing discharge piping and the seal removed after taking off the impeller. On some pumps, however, it is necessary to take the unit into the shop and pull bearings or to completely disconnect the piping to get at the parts that will permit replacement of the seal. Such construction should be avoided when possible.

As mechanical seals are relatively new, it is important to recognize the differences between them. The basic construction of mechanical seals varies widely and frequently operators become discouraged because they do not have initial success when their basic problem is misapplication of the type of seal. Mechanical seals that have Neoprene, Hycar or synthetic rubber elements of similar characteristics cannot be operated above 250 F. Thus, seals with "O" rings or bellows of this material can be used only within that temperature range. When using higher temperature materials up to 450 deg seals become more expens-

sive and normally require a greater diameter because usually chevrons or tapered wedges are used that require a greater diameter to provide correct resilience and operation of the seal.

Most all seal manufacturers make both unbalanced and balanced seals. Unbalanced seals are less expensive, usually are not made in cartridge form so that they are pre-tested, and should not be used where the pressure on the seal exceeds the manufacturer's rating. When unbalanced seals are used at pressures in excess of 75 lb differential across the seal, the life of the seal is appreciably reduced and normally unbalanced seals should not be used at pressures above 125 lb even for intermittent operation as the faces may gall, particularly with poor lubricating fluid being handled in pump.

A balanced seal is a seal so designed that the pressure between the wearing faces of the seal remains essentially constant over a wide range of pressures on the seal. With properly balanced seals it is possible to go up to virtually any pressure and obtain excellent life. Standard balanced seals can be used for pressures of 400 to 600 psi without any special consideration but for pressures in excess of this it is wise to make sure that the seal manufacturer is familiar with your requirements so he will make certain that the seal is properly balanced for the required operating range. Obviously the requirement that stuffing box pressure be maintained on the packing gland is not necessary when balanced mechanical seals are used.

Engineers and operators frequently ask: "What does it mean when you say balanced seals?" It sounds to them as if they are getting something for nothing and a good operator or engineer knows that this sort of thing just doesn't happen. The illustration shown in Fig. 2 indicates the forces on balanced and unbalanced seals. Essentially on an unbalanced seal the force resulting from the pressure on the rotating ring is carried by the seal faces acting as a thrust bearing. On a balanced seal most of the force that was carried by the seal faces is taken by a sleeve firmly attached to the pump shaft transmitting the unbalance force to the pump thrust bearing. The diameter of the rotating ring in relation to this sleeve is so adjusted that there is as much pressure between the faces of the seal tending to open them as there is behind the rotating ring tending to close the faces. Exactly what happens between the seal faces is of no practical interest to engineers or operators. It is not a straight line pressure drop and is not always the same for different fluids. The best way to balance a seal is simply to vary the diameter of the faces and operate the seal under a wide range of pressures and measure the heating of the seal and power consumption of the driver. On an unbalanced seal the power consumption will go up directly with the pressure as would be expected with a given friction coefficient and increasing load. With a balanced seal the power consumption to drive the seal goes up very slowly as the pressure is increased over a wide range indicating that it is very nearly in balance. Normally it is desirable to have the seal slightly unbalanced so it will tend to close as the pressure increases to prevent the seal from opening on a pressure surge but that at no time over the pressure range does it exceed the proper bearing unit pressure between the seal faces.

On light hydrocarbons where relatively high suction pressures exist and on applications where poor lubrication quality exists in the fluid pumped, it is highly desirable to use balanced seals. Many users standardize on balanced seals because then they do not need to worry if the pump with the seal is transferred to a different operation with higher suction pressures.

Often it is of interest to verify that a seal can be used to handle a particularly "tough" fluid but operators hesitate to experiment on pumps in the process because of their relationship to the operation as a whole. It is relatively inexpensive to build a testing device that will permit you to circulate fluid being pumped at the temperature being pumped through a dummy pot and operate the seal of the actual size and speed of the pump to determine whether or not the materials used and faces are correct for the application. This same test apparatus can be used to check cartridge type seals before they are put in warehouse stock if the maintenance department wishes to repair seals on this basis. Such a testing apparatus that can be used either in the maintenance shop or in connection with the application of seals to pumps in the field is illustrated in Fig. 3. For small operators such a test apparatus can be borrowed from seal manufacturers if he has a specific problem he wishes to test without disturbing his process other than to put in a by-pass line.

A number of years ago double seals were used wherever the pressures exceeded those which were usable under unbalanced seal conditions. A double seal consists of a seal mounted next to a pump impeller and another one at the bearing end of the stuffing box with fluid at a pressure normally above that of the pump suction inserted between the two seals. Usually this requires a separate source of pressure to put oil or similar fluid between the seals and greatly increases the cost and complications of the installation. To some extent this type of installation has also been used where abrasives have been present in the fluid pumped under the theory that with the pressure higher between the double seals than in the suction area of the pump, clean fluid would flow through the seals rather than the fluid containing abrasives. With further advances in balancing seals and in providing wearing faces which are very resistant to abrasion, the double seal is rapidly being replaced. It is still used in some places where extremely hazardous fluids are being pumped and the chamber between the seals is flushed with the fluid which would control any leakage and give indication of failure of the inner seal.

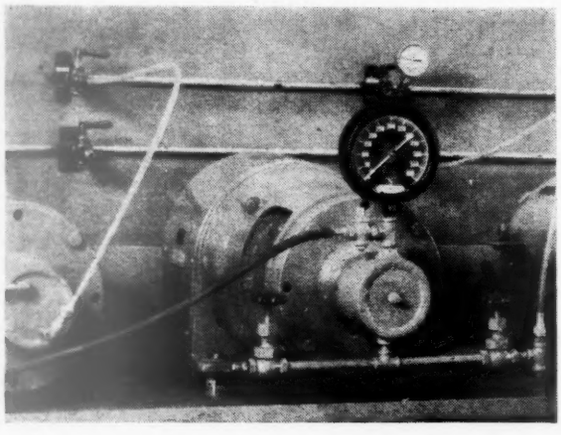
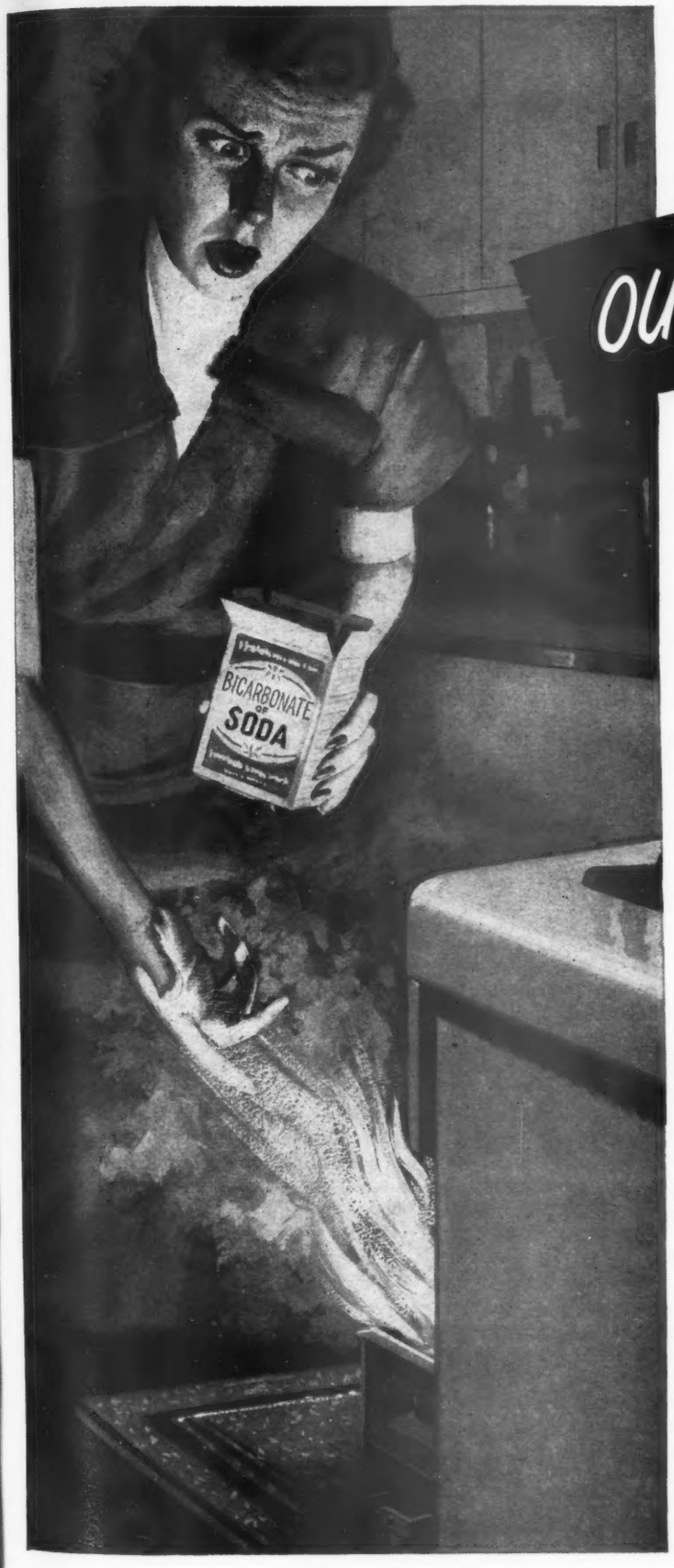


FIG. 3. Calibrated equipment to simulate field conditions of stuffing box in pumps. By adjusting differential pressure on seal and measuring wattage used in overcoming friction between seal faces, desired balance can be established prior to assembly for use.

Conclusions

1. The number of seals used on centrifugal pumps has grown rapidly in the past 10 years and appears destined to replace packing on most applications.
2. Seals are limited to temperatures below 250 F with standard materials and 450 F with Teflon and Kel-F.
3. Use unbalanced seals for fluids with good lubricating qualities to 75 psi; balanced seals for higher pressure.
4. Pumps should be designed specifically for seals for best results.
5. Users should make sure proper type and material of seal is used for each application. * * *



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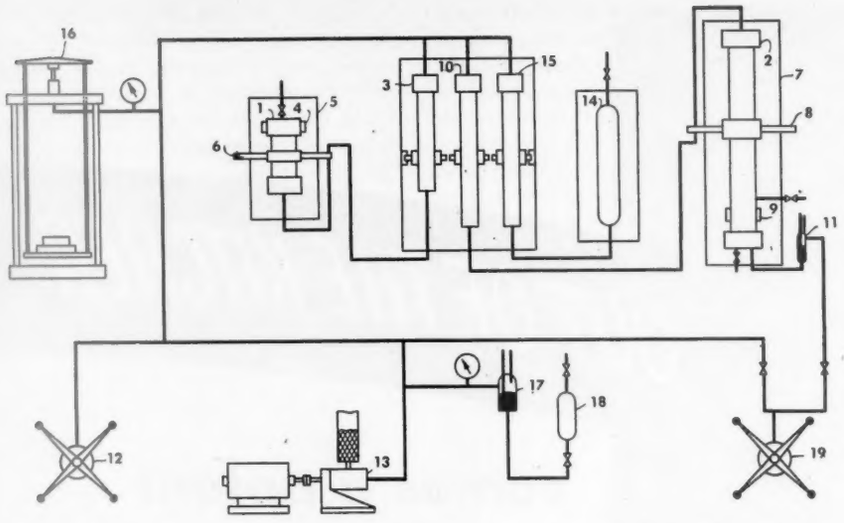

FIG. 1. Diagram of apparatus for phase studies on hydrocarbon systems.

PHASE BEHAVIOR of Hydrocarbon Systems

M. R. DEAN* and FRED H. POETTMANN*

THE increase in the depth, and thus the range of temperature and pressure, at which hydrocarbon reservoirs are being discovered has necessitated the design and construction of apparatus that will accurately measure the physical properties of the reservoir fluid found at these depths. These fluids are often of the gas-condensate type and are usually characterized from a practical standpoint by the following three criteria.

1. The stock tank liquid usually has an API gravity at 60 F of 50 or greater.
2. The production is colorless or straw colored but never the green or black colors typical of crude oils.
3. The gas-oil ratio of the reservoir fluid at the stock tank is usually greater than 5000 cu ft per barrel.

In the range of temperature and pressure at which these gas-condensate systems occur the phenomenon of retrograde condensation usually takes place.

The properties of the gas-condensate system that are of interest to the reservoir engineer are: Dew-point pressure of the system at the reservoir temperature, the effect of temperature and pressure on the quantity and composition of the liquid produced by both normal and retrograde condensation and the compressibility factor of the reservoir fluid at both constant composition and for the varying composition that occurs upon pressure depletion.

Various types of apparatus have been described in the literature for use in studying gas-condensate systems.[2, 11, 8, 1, 4, 3, 10, 9] In designing the apparatus described here an attempt is made to include the best features of the designs previously published in addition to incorporating several new features.

The apparatus was designed to make measurements of pressure, temperature, and the volumes of each and all coexisting phases, both liquid and gas. The above measurements plus visual observation of the fluid in the cell make possible the determination of the dew-point pressure, the bubble point pressure and the critical temperature and pressure of the system under study.

The central units of the apparatus are two ""windowed" steel equilibrium cells each contained in a controlled temperature air bath and each connected with flexible steel tubing to another steel cell of comparable volume in a U-tube arrangement. The windows in the equilibrium cells permit visual observation of the contents. Each cell connected to a windowed equilibrium cell contains a device for accurately measuring the volume of the mercury contained in it. These cells will be referred to henceforth as "mercury volume measuring" cells or "MVM" cells. Supplementary equipment is provided to measure the pressure in the equilibrium cells, the volumes of hydrocarbon material charged to them and their temperatures. There is also included a motor-driven piston pump to supply a steady quantity of oil at high pressures.

A simplified diagram of the apparatus is shown in Fig. 1. The smaller of the two equilibrium cells 1, designated the "PVT cell" has a capacity of approximately 750 cc. The PVT cell is connected by flexible steel tubing to its MVM cell 3, which contains a device for measuring the volume of mercury it contains. Visual observations are made through the windows 4. The air bath 5 is mounted on trunnions 6 in such a manner that the cell and bath may be rocked as a unit. Suitable thermostatic controls are provided for the electric heaters in the air bath to maintain the air temperature constant. The air is circulated rapidly with a motor-driven fan mounted in the bath.

This cell was designed for ease and rapidity of operation. The effective volume is varied by varying the volume of mercury contained in it from the MVM cell. The windows are situated in such a manner that the volumes of all phases in the cell may be determined by measuring the differences in the angle of tilt necessary to place the various interfaces at the reference point on the windows in the manner explained by Eilerts[3] and illustrated by Fig. 2. The method is very rapid and convenient. The precision of this method of volume measurement is approximately ± 2 cubic centimeters.

The PVT cell was not provided with convenient facilities for sampling the phases. Samples can be taken, however, by placing the cell in a vertical position and removing all the vapor phase at constant pressure following which any part of the liquid phase may be taken as sample.

The larger of the two equilibrium cells 2 is designated as the "piston cell" and has a volume of approximately 2700 cc. It was designed to allow certain operations impractical with the PVT cell. The piston cell is mounted in a controlled temperature electrically heated bath 7 mounted on

*Phillips Petroleum Company.

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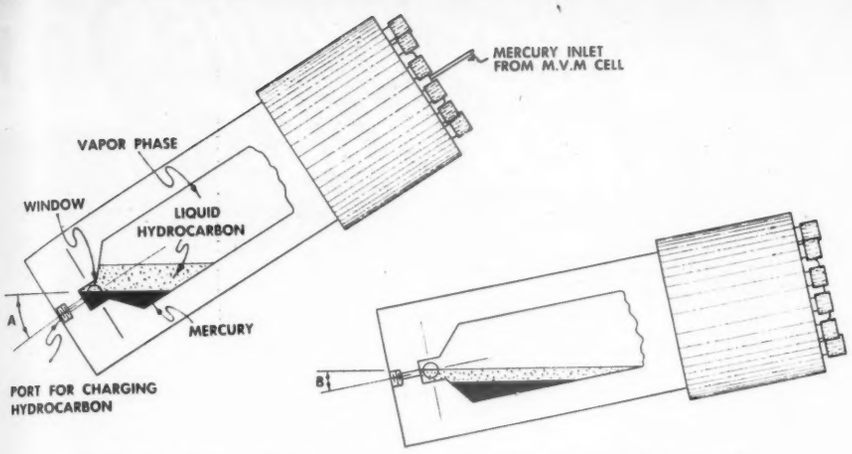

FIG. 2. Phase volume measurement with PVT equilibrium cell.

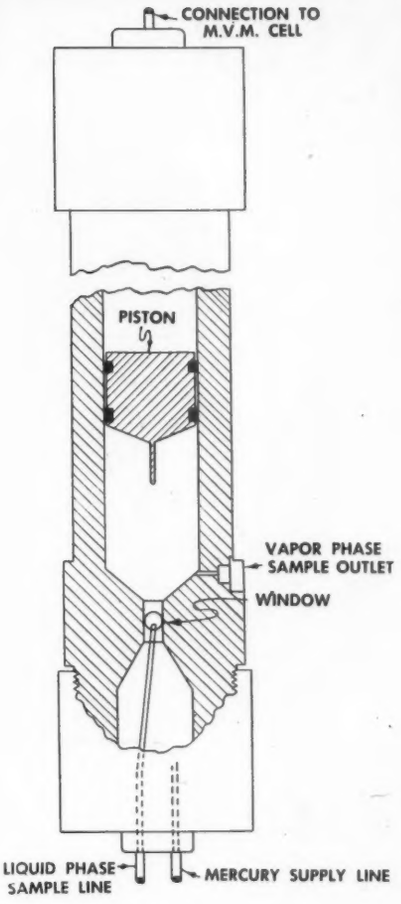

FIG. 3. Piston cell.

trunnions 8 to allow the cell and bath to be rocked and thus equilibrate the hydrocarbon phases in the cell. Observation of the contents is made through windows 9. The air in the bath is circulated rapidly with a motor-driven fan mounted inside the bath. The effective volume of the cell is varied by changing the position of a freely floating piston by pressuring oil into or out of the companion MVM cell 10. Cell 10 with its mercury level indicator serves to locate the position of the piston in the piston cell and thereby fix the effective volume of the cell above the level of the windows. The effective volume of the cell below the windows is varied by changing the quantity of mercury in reservoir 11 with volumetric pump 19. This arrangement is also used to measure the volume of liquid hydrocarbon phase by placing the cell in a vertical position and observing the difference in volume readings when the gas-liquid interface is centered on the windows and when the liquid hydrocarbon-mercury interface is centered on the windows.

Tests were made using isooctane at room temperature to determine liquid "hang-up" and the drainage time required to reduce the "hang-up" to an unimportant amount. It was found that a drainage time of 2 hours reduced the "hang-up" to less than 0.2 cubic centimeter.

The essential features of the piston cell are shown in Fig. 3. The interior of the cell consists of three sections. The upper section having a capacity of about 2500 cc is normally the space occupied by the gas phase. The lower section having a capacity of about 140 cc is normally occupied by liquid hydrocarbons and controlled volumes of mercury. The small bore section connecting the upper and lower sections contains the glass window assemblies. All interior surfaces are polished to reduce the volume of liquid "hold-up" to a minimum.

Provisions were made to allow either gas or liquid phase samples to be taken at will. The tube that enters at the base and terminates at the level of the windows is used to withdraw liquid samples. This arrangement allows practically complete recovery of all liquid in the cell by placing the liquid hydrocarbon-mercury interface just below the level of the tube opening. Gas samples are removed through a tube in the side of the cell just above the windows. During removal of a gas phase the pressure can be maintained constant by forcing the piston down at the proper rate.

The free-piston type pressure measuring instrument 16 is connected into the oil-filled manifold. Several bourdon-tube pressure gages are situated at various points in the system for convenience. These gages are used only to indicate pressure. Piston gage 16 is used for all measurements where accuracy is required.

Oil at high pressure and at controlled rates from 60 to 250 cc a minute is supplied by pump 13 powered by variable speed motor.

Gas samples are charged to either of the two equilibrium cells from cell 14. This cell, of 2500 cc capacity is mounted in an oil bath whose temperature is thermostatically controlled. The cell is connected by flexible steel tubing to MVM cell 15, which is of similar capacity and is identical to cell 10. Cell 15 also contains the device that provides for measuring the volume of gas contained in cell 14.

All three MVM cells 3, 10, and 15 are placed in a common water filled thermostatically controlled bath and are serviced with high pressure water-white mineral oil from pump 13.

Liquid sample bomb 18 is attached to cell 17 with flexible steel tubing and a metered quantity of liquid sample can be charged into an equilibrium cell by mercury displaced from cell 17 with oil from pump 12. Cell 17 was provided with two electrical contacts to indicate the extremes in mercury level. Pump 12 is a calibrated, hand operated piston-type pump of 250 cc capacity, which will measure volume changes with a precision of ± 0.01 cc.

Pressure Measurement. A free-piston type gage manufactured by the American Instrument Company was used to measure all pressures. The mean diameter of the piston was measured by the Bureau of Standards, which also adjusted the mass of each weight used with the piston gage. The correction to the gage constant for the crevice between the piston and cylinder was determined using the method of Meyers.[5] The pressures measured by the gage were corrected for the difference in height between the mercury in the equilibrium cells and in the MVM cells. It is considered that the pressures measured with the piston gage are correct to ± 2 psi at any pressure within its range. Its sensitivity is such that a pressure change of 0.2 pound per square inch can be detected.

Temperature Measurement. All temperatures are measured with single-junction iron-constantan thermocouples in conjunction with a Leeds and Northrup portable precision po-

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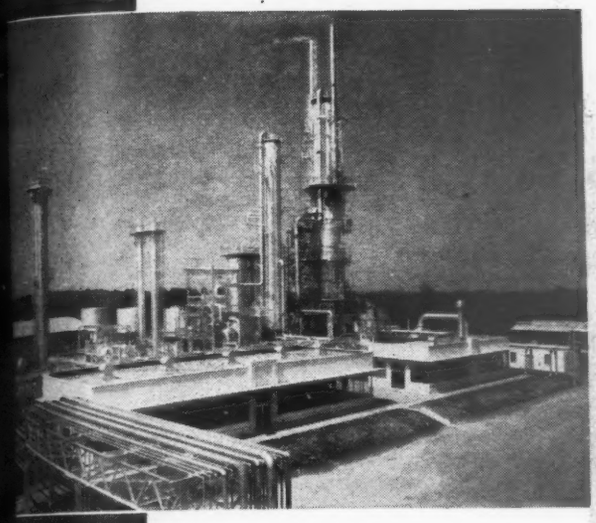

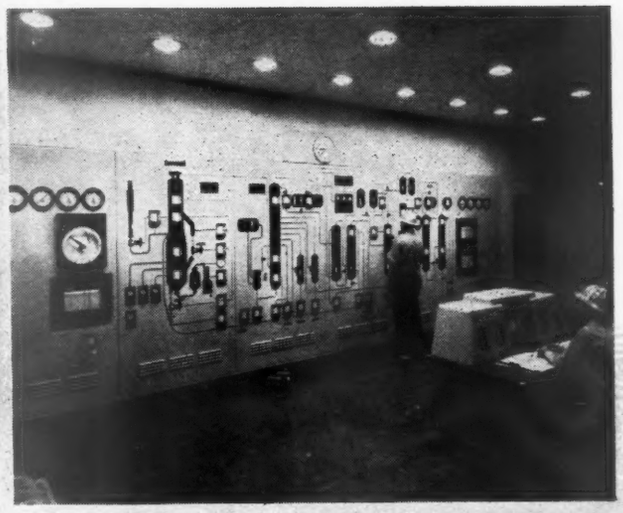

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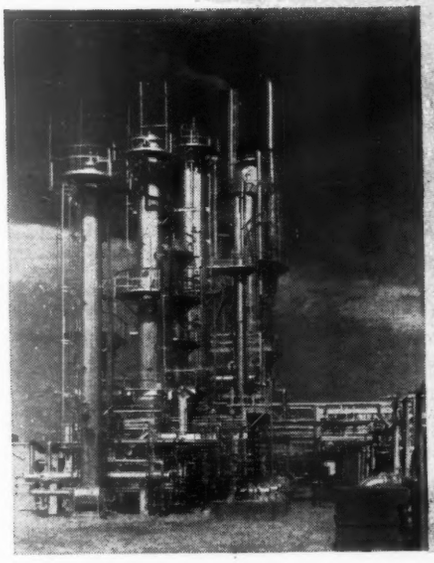

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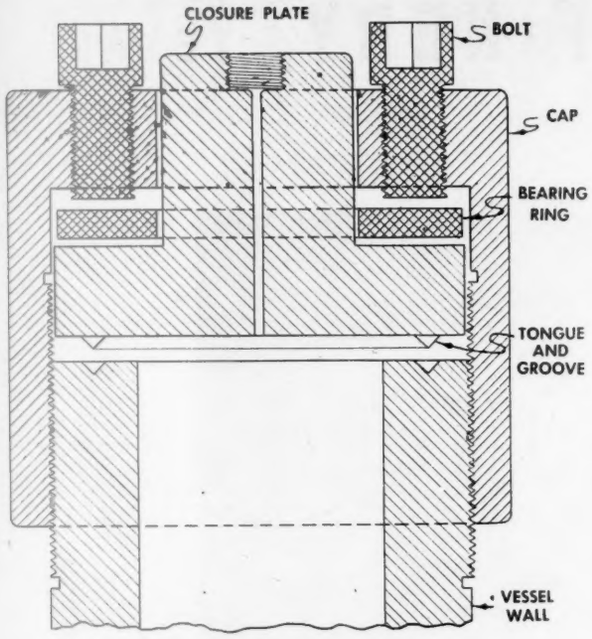
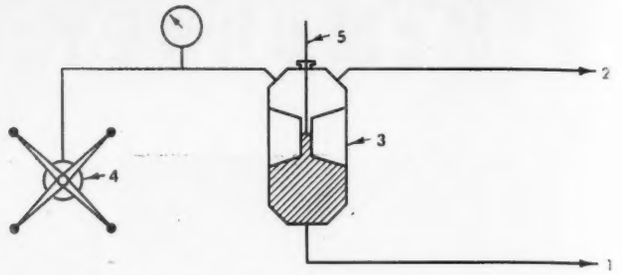


FIG. 4. Partially exploded view of cell closure.



1. Mercury line to bottom of equilibrium cell.
2. Oil line to space between windows.
3. Interface cell.
4. Volumetric pump.
5. Electrical contact.

FIG. 5. Window seal pressure system.

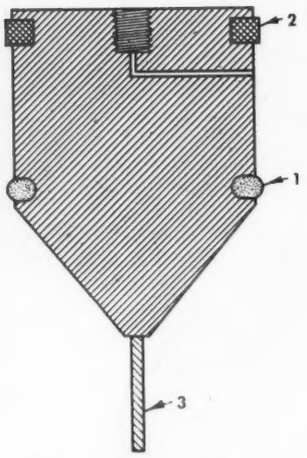


FIG. 6. Floating piston.

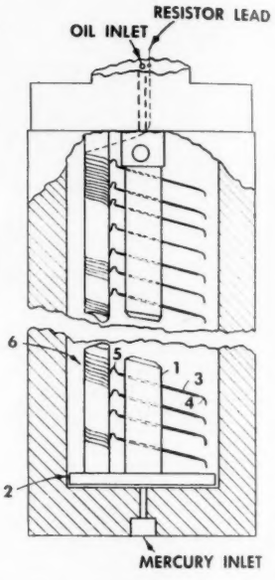


FIG. 7. Mercury volume measuring device.

tentiometer. The thermocouples were calibrated with Bureau of Standards certified mercury-in-glass thermometers and it is considered that the temperatures in the range of 0 to 325 F are measured with an error not exceeding 0.5 F. The thermocouples are imbedded in small holes drilled ¾ in. deep in the body of the cell.

Pressure Vessels. Type AISI 410 stainless steel (12 per cent Cr) was chosen as the material for both windowed equilibrium cells and for the three MVM cells because of its resistance to corrosion by hydrogen sulfide and carbon dioxide and because it possesses a greater yield strength than most other suitable stainless steels. The design of the vessels is such that the maximum fibre stress is 20,000 psi at an internal cell pressure of 10,000 psi. The design permits use of the cells at temperatures from 0 F to 400 F with cell pressures up to 10,000 psi, and from 0 to —60 F with cell pressures up to 5000 psi. Sage[7] reported no significant amalgamation of his stainless steel (18 per cent Cr 8 per cent Ni) with mercury at 600 F. Thus it is believed no significant amalgamation will occur with the stainless steel used here.

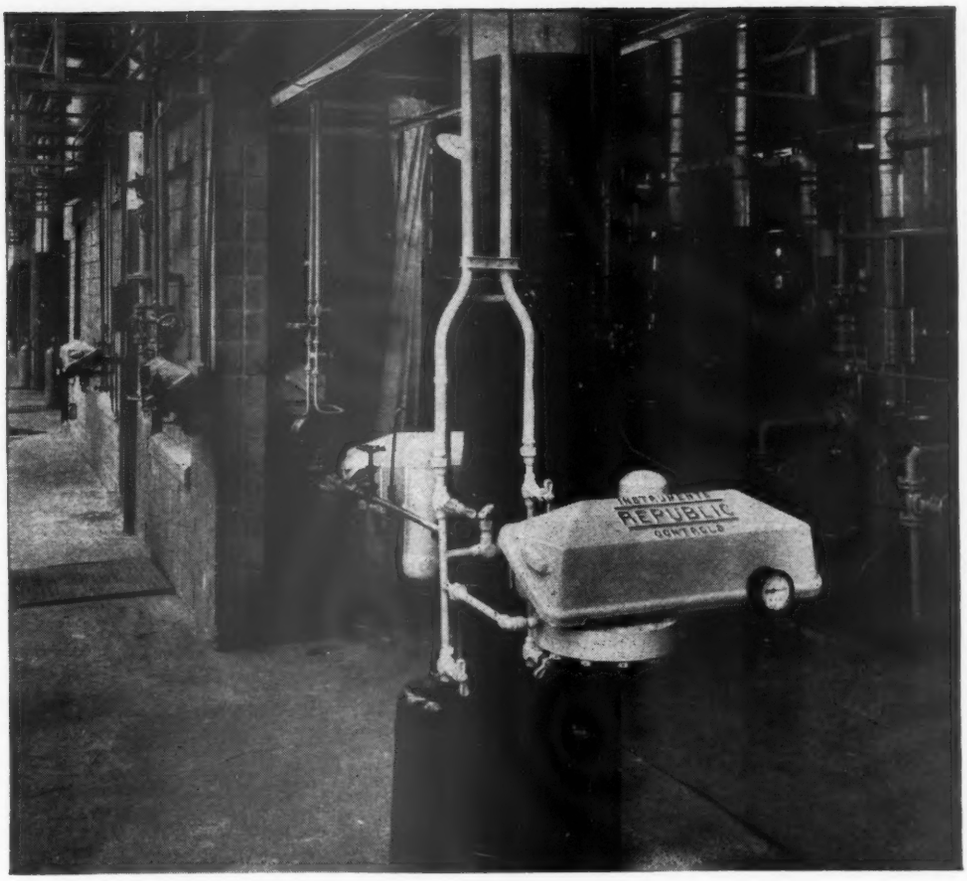
Fig. 4 shows the essential details of the cell closure. Its main feature is the absence of a gasket. The pressure seal is effected at the tongue-and-groove by pressing the ground-in surfaces together with bolts. The closures on the three MVM cells were successfully tested with oil at 15,500 psi. A torque of 70 ft-lb was applied to each bolt in making up the closure.

The design of the cell windows is essentially that as described by Eilerts[3]. It consists of a double window with a water-white mineral oil seal between the windows. The pressure on the oil between the windows is maintained equal to the pressure in the cell by an arrangement as shown in Fig. 5. The pressure from the equilibrium cell is transferred to the oil by means of interface cell 3. In order to avoid errors in volume measurement, the mercury level in the interface cell is kept at a fixed level within a constricted portion of cell 3 by means of electrical contact 5 and volumetric pump 4.

Floating Piston. A drawing of the floating piston is shown in Fig. 6. The separation between the mercury above the piston and the hydrocarbon fluid content of the cell is effected by means of rubber 0-ring seal 1 near the bottom of the piston. The piston is held in a centered position in the cell bore with piston-ring 2 made of Teflon. When the piston is at the bottom of the cell, pin 3 is used to position the piston at a reference mark on the cell windows.

Volume Measuring Device. Fig. 7 shows a section of the device as installed in an MVM cell. The device consists of two flat steel bars 1 fastened together with counter-sunk flat head screws and attached to the base of the cell closure. To the lower end is fixed a disk of Bakelite 2 having very nearly the same diameter as the interior of the cell. This arrangement maintains the axis of the bar coincident with the axis of the cell. At intervals of 7/16 in. steel pins 1/16 in. in diameter and inclosed in plastic electrically insulating sleeves are clamped between the bars. To the lower end of each pin a short length of platinum wire 4 was welded to serve as a contact point with the mercury. The upper end of each pin is welded to a different lead wire 5, from the wire wound resistor 6. The upper terminal wire of resistor 6 is conducted through the head of the cell by means of an electrically insulated lead and connected into a Wheatstone bridge.

As the level of the mercury changes the number of contacts submerged in the mercury changes and as each contact point leaves or enters the mercury the net resistance of the circuit will change in a stepwise manner. As each contact is connected into the resistor at a different level each has a



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unique resistance value that serves to identify it. The Wheatstone bridge measures the resistance of the circuit and thereby identifies the pin making contact with the mercury surface. As the vessel was fabricated to have a very nearly constant diameter (±.003 in.) the volume of mercury at each contact is a simple function of its height above any convenient reference level. In order to make the contactor unit into a device for measuring any volume it was necessary to provide a tilting action of proper magnitude to the cell so that for any mercury level a contact can be made by tilting the cell forward or backward. When contact is made, as evidenced by a sudden change in resistance, the angle of tilt is measured.

Each MVM cell was calibrated by measuring the volume of successive portions of mercury withdrawn and relating the cumulative volume withdrawn with the circuit resistance and angle of tilt required to cause the platinum wire to contact the mercury surface.

Considerable difficulty was encountered in finding a liquid to overlay the mercury which could be easily pumped at high pressures and at the same time allow exactly reproducible contacts to be made between the tips of the contact pins and the mercury surface. It was found that compounds such as acetone, alcohol, or glycerin seriously interfered with the mercury contacts. Common lubricating oil was unsatisfactory because in addition to interfering with the pin-to-mercury contact enough mercury emulsion was created to interfere seriously with the reproducibility of the readings. It was found that water-white mineral oil had all the properties desired in that it did not emulsify the mercury, it permitted exactly reproducible contacts between the pins and mercury, it could be used in the hydraulic system and pump with no dangers from corrosion and is a good lubricant.

The precision of the volume measurement is ±0.3 cc and the accuracy is considered to be ±0.5 cc for any volume within capacity of the cells.

In order to attain the greatest accuracy in making volume measurements corrections must be made for the effects of temperature and pressure upon (a) the volume of mercury in the system; (b) the volumes of the equilibrium cell and the companion MVM cell. The effect of temperature and pressure upon the mercury density was corrected for by use of the data of Smith[11]. The effects of pressure upon the volumes of the equilibrium cells and the MVM cells were determined by direct experiment. The effects of temperature on the volumes of the cells were computed.

TABLE 1. Comparison between experimental compressibility factors for methane and those by Sage[5] at 100 F.

Pressure psia	Compressibility factor: Experimental data points	Smooth data —Sage	Difference
1,055	0.9007	0.903	−0.0023
2,030	0.8542	0.852	+0.0022
2,528	0.8463	0.847	−0.0007
3,029	0.8550	0.855	0.0000
4,017	0.9067	0.907	−0.0003
6,065	1.0761	1.074	+0.0021
6,759	1.1400	1.139	+0.0010
8,062	1.2655	1.261	+0.0045
10,060	1.4533	1.451	+0.0023
9,111	1.3647	1.361	+0.0037
7,143	1.1750	1.175	0.0000
5,186	0.9991	0.997	+0.0021
3,103	0.8588	0.858	+0.0008
1,078	0.8982	0.902	−0.0038
	Average deviation		0.0018
	Algebraic deviation		+0.0116

Before any volume measurement on an equilibrium cell can be made a "zero" volume indication on the appropriate MVM cell must be noted. This procedure is simple with the PVT cell and the gas-pumping cell and consists of filling the cells with mercury and noting the volume indication with the MVM cells at various pressures and at the reference temperature of 100 F. These various volume indications are then plotted against pressure, and the value at zero pressure taken as the reference or "zero" volume indication. In the case of the piston cell, the same observations are made with the stem of the piston set at the reference dot in the window.

In order to test the over-all performance of the PVT cell, the compressibility factor of methane was determined at 100 F over a range of pressures from 1000 to 10,000 psi. These experimentally determined compressibility factors are compared in Table 1 with the smoothed data published by Sage et al[5]. The small differences found demonstrate that the over-all accuracy of the pressure and volume measurements are easily within the requirements of the type of studies in which they will be used.

Fig. 8 is an example of the compressibility factor measurement of a gas-condensate system as determined in the PVT cell. The circles are the experimentally determined compressibility factors of the original fluid for the case where the pressure was reduced by increasing the volume with no change in composition. The crosses represent experimental values for the case where the pressure was reduced by progressively removing the equilibrium vapor phase thus effecting changes in composition of the fluid remaining in the cell. This operation is the equivalent of producing a gas-condensate type petroleum reservoir by pressure depletion.

Figs. 9 and 10 show the isotherms at 140.5 F and at 190.5 F of a mixture of the following composition,

	Mole per cent
Ethylene	68.3
n-Butane	31.7
	100.0

These isotherms were determined with the piston cell. The 140.5 F isotherm is in the normal region of PVT behaviors whereas the 190.5 F isotherm is in the region of retrograde behavior. The dew-point of the 140.5 F isotherm and the lower dew-point of the 190.5 F isotherm is typical of the type of isotherm which approaches the dew-point at a very sharp angle. The manner in which the dew-point pressures were determined using the piston cell is shown in Figs. 11 and 12. The liquid accumulation was plotted against the pressure and the curve extrapolated to the zero liquid accumulation line, the intersection with this line along with visual observations was taken as the dew-point pressure. The construction of the pis-

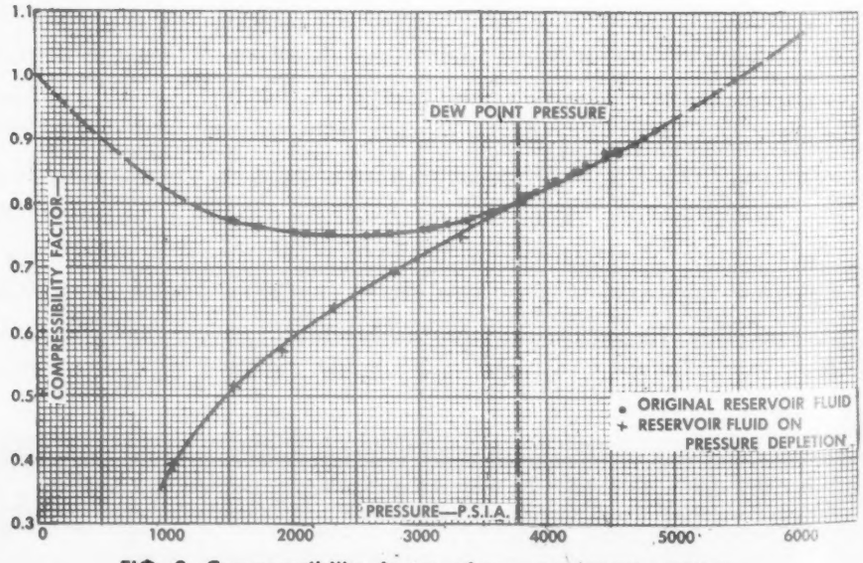

FIG. 8. Compressibility factor of gas condensate system.

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TWIN SEAL
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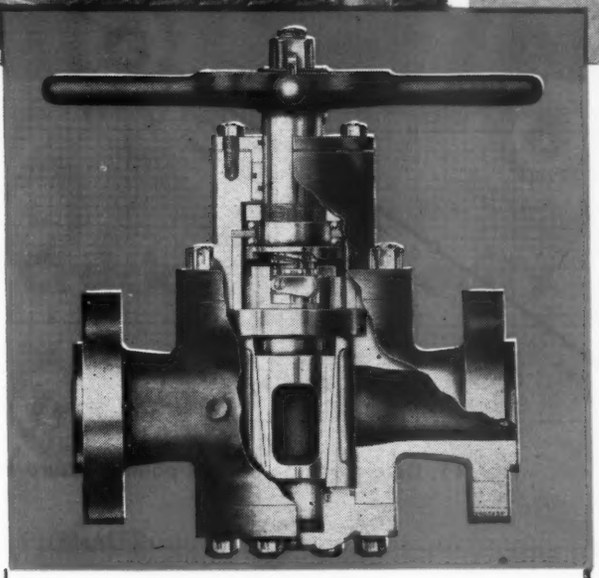

- ✓ No lubrication required.
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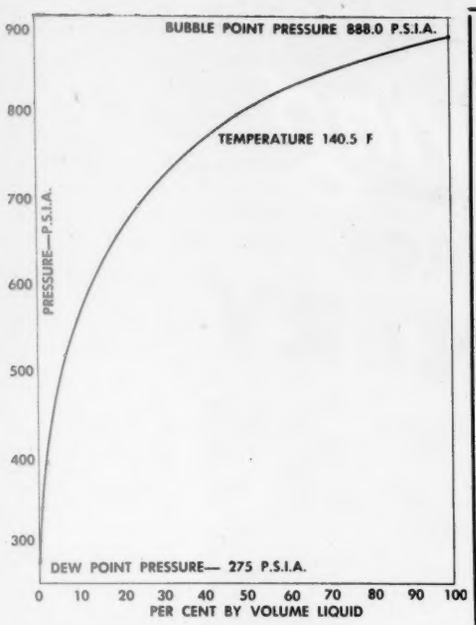

FIG. 9. Effect of pressure upon volume of liquid phase.

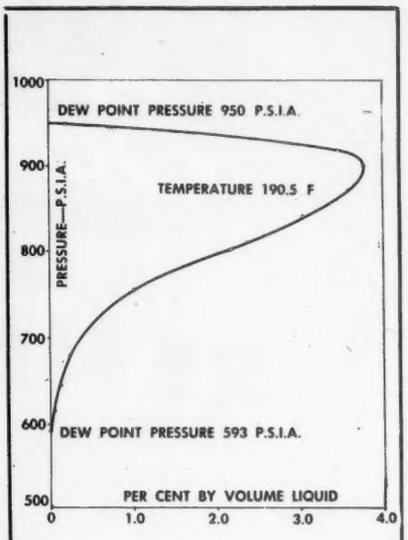

FIG. 10. Effect of pressure upon volume of liquid phase.

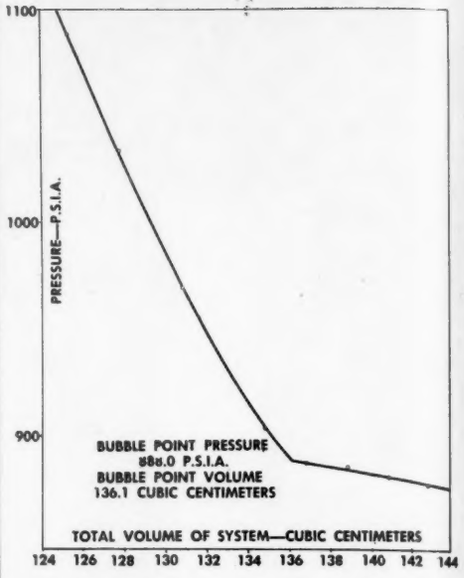

FIG. 13. Determination of bubble point pressure at 140.5 F.

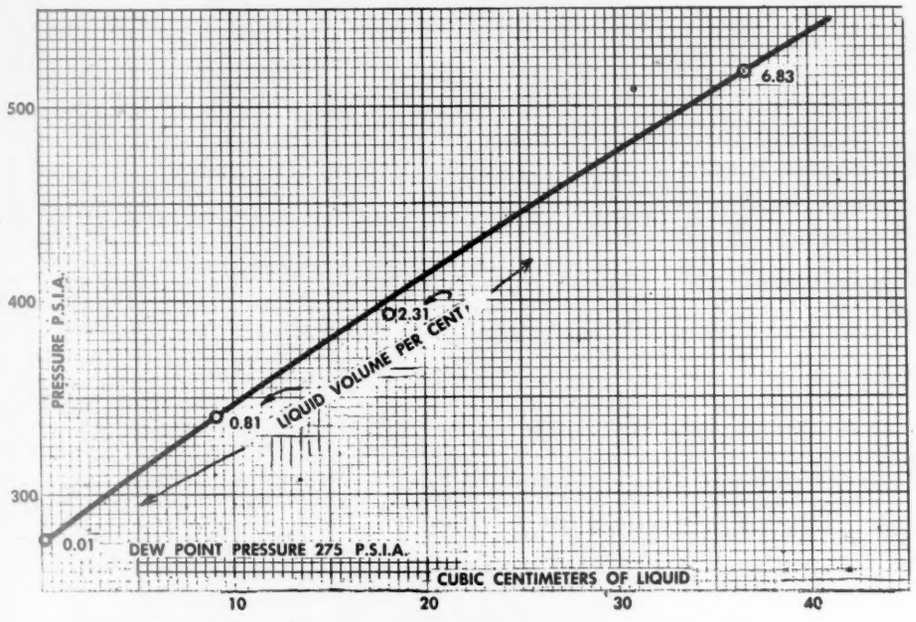

FIG. 11. Determination of dew point pressure at 140.5 F.

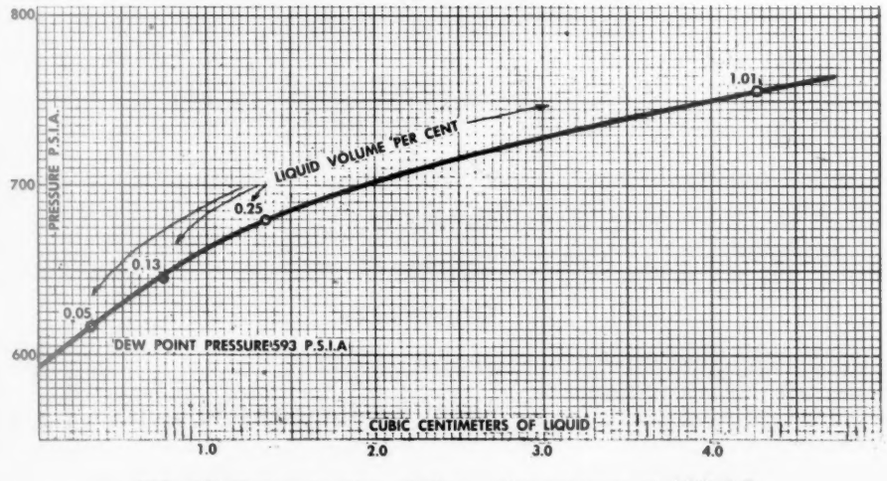

FIG. 12. Determination of dew point pressure at 190.5 F.

ton cell is such that very small quantities of liquid can be measured, this is an aid in determining dew-points of this nature. The small figures plotted alongside the experimental points of Figs. 11 and 12 indicate the percentage of the total volume occupied by the liquid phase.

The bubble-point of the mixture was determined by plotting the total volume of the system against the pressure and observing the break in the curve. The pressure at which this break occurs is the bubble-point pressure. Fig. 13 illustrates this.

The diagrams show that the various measurements necessary for a laboratory study of a gas-condensate type system can be made accurately with the equipment just described.

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11. Smith, L. B., and Keyes, F. G., Proc. Am. Acad. Arts and Sci. *69*, 313 (1934).
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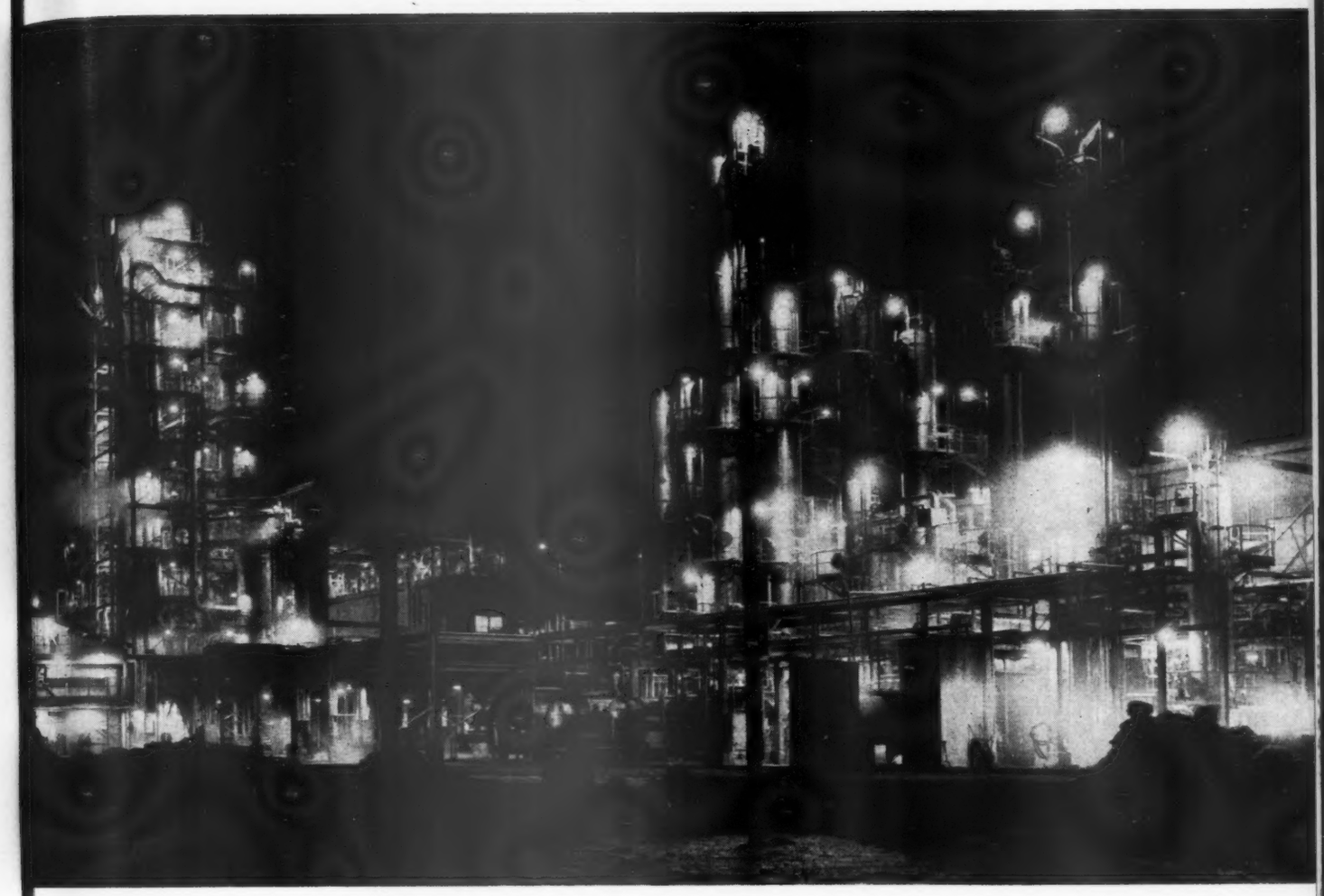
Acknowledgment

The authors wish to thank Phillips Petroleum Company for permission to publish this report and A. F. Bertuzzi, R. F. Wiemer and T. A. Matthews for their aid in the assembling and testing of the equipment. * * *



Shell's new cat cracking plant and light ends heater at Montreal East Refinery silhouetted by its own night illumination.

Refinery Installs Cat Cracking Capacity

"Last word" in fluid cracking units, blending systems begin operations at Montreal, Canada, using new type catalyst

HARRY CHAPIN PLUMMER

SIGNALLY advancing the status of Montreal East as one of the most modern and best equipped petroleum refinery centers on the North American continent, the Shell Oil Company of Canada Limited inaugurated formally, in June, its fifth large-scale expansion on the same site within a period of less than 20 years. Productive capacity has been increased to 5 times that of the original establishment of 1932, which was built to handle 175,000 gal of crude daily.

The new layout represents a total investment of $20,000,000 over a two-year period and comprises 320 acres, extending 4400 ft back from Montreal's chief motor thoroughfare, Sherbrooke Street, and having an average width of more than 3000 ft.

Among the wealth of up-to-the-minute installations of the greatly magnified plant are catalytic cracking, instantaneous vaporization and polymerization units that make possible the daily routine intake of 900,000 gal of crude, to produce 440,000 gal of gasoline, more than a quarter of a million gal of distillate fuels, 145,000 gal of heavy oils, such as diesel, 30,000 gal of naphtha and 18,000 gal of liquid petroleum gases. The latter, formerly burned as fuel gas, are now recovered, as well.

EXCLUSIVE

An important auxiliary feature is the in-line blending plant, the only one of its type in Canada, which is capable of blending more than 100,000 gal per hour with a uniformity and accuracy not possible with older systems.

The design of the catcracking unit is the most compact ever built; the over-all height — generally beyond —200 ft—having been reduced in the Shell installation to 118 ft through a

major revision in the catalyst transfer method. This arrangement results in conservation of steel and other scarce materials. The new type catalyst it employs yields a higher octane gasoline.

The refinery's 25,000-bbl process rating is the combined intake capacity of the two topping plants where crude is initially broken down and passed on for refining in other units. The cat-cracker has a 10,000-bbl daily capacity of flashed distillate and gas oil for high octane gasoline production. The in-line blending plant balances, in exact conformity with pre-set formula, the six major components of motor-gasoline and adds the likewise prescribed proportions of tetraethyl lead, dye, and inhibitor, at the rate of 100,000 gal per hour. Operations are facilitated by refinery storage tanks having a total capacity of 1,000,000 gal.

Safety and climatic considerations were impelling factors in the design and fulfillment of the expansion program. The engineers have put into practice the latest proved devices to prevent, by anticipation, mishap or accident and have installed equipment with an understanding regard for Montreal's severe winter, wherein the thermometer registers an average of between 15 and 20 deg below zero and of about 2 ft of snowfall per month. So the installations had to be placed indoors wherever possible or invite serious freeze-up during shutdowns, maintenance trouble, interrupted operation, or costly insulation. Where equipment could not be adequately housed, the units were grouped closely, to confine piping and to avoid snow accumulation and drifts in open pockets between them. Pipe laid outdoors is insulated by steam or buried 5 ft below the ground.

Dictates of weather and design made possible by new safety techniques have resulted in the development of a consolidated central unit, within which a single, but complex, control-board regulates the cat-cracker, vacuum flasher, gas recovery and treating plants.

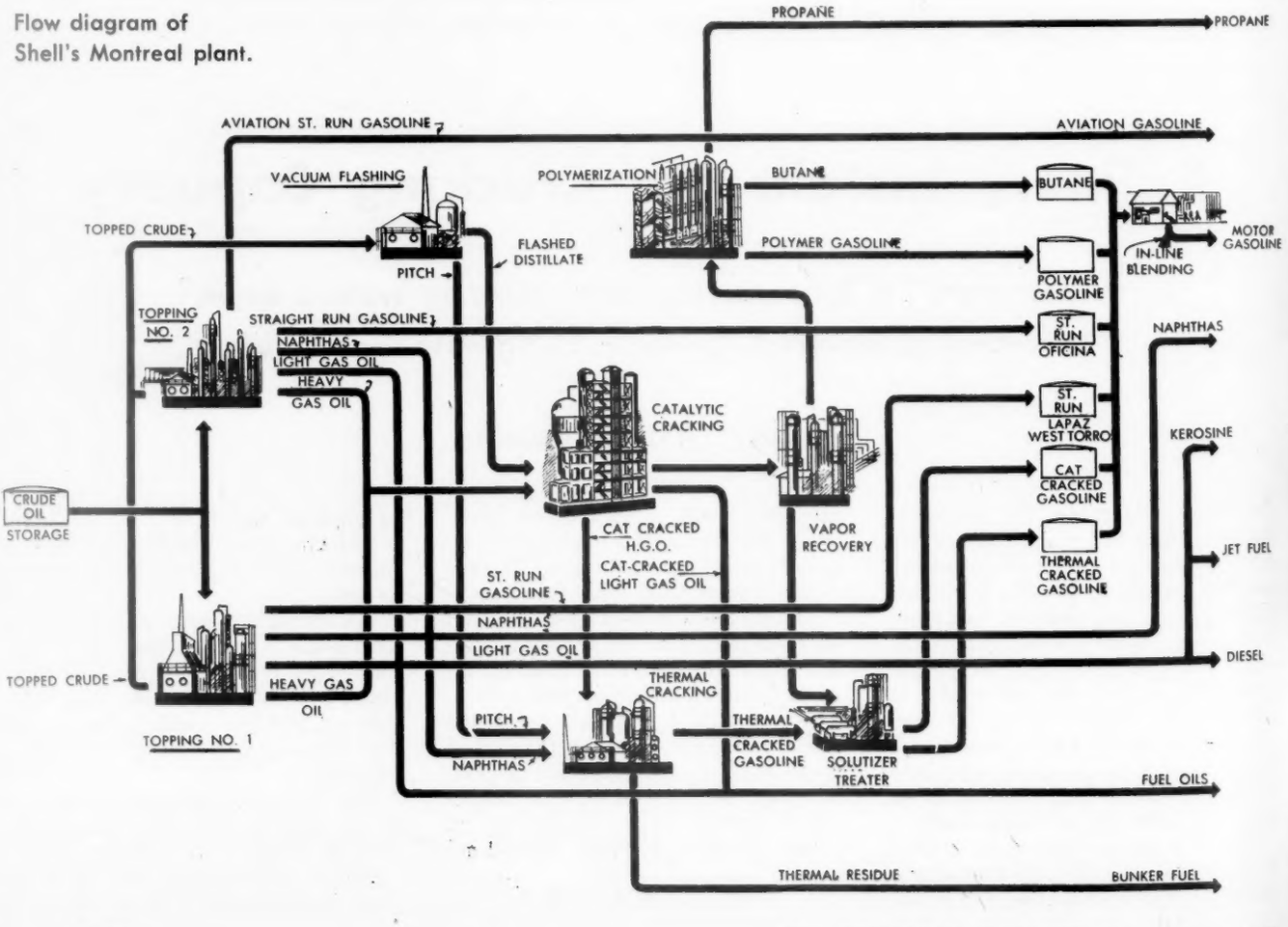
Four separate safety systems monitor the refinery operations, each augmenting the constant control of potentially dangerous elements through 24-hour uninterrupted functioning. A mechanical draft system ventilates the entire building group to prevent accumulation of gases. An extensive water-spray system can apply 2500 gal of water every minute to the entire interior of the structures—well nigh instantaneously. A new automatic gas detection and alarm device, with electronic sensitivity, covers every place where petroleum products are piped or processed. Finally, a thermal alarm system stands sentinel in those upper parts of the operating unit where the working force seldom goes.

For the gas detection system, which ferrets out combustible gases before their accumulation approaches a hazardous stage, the Shell Company drew upon its practical experience of several years at five diesel-powered pumping stations on a Shell products pipe line from its Wood River, Illinois, refinery. The system samples continuously the air in pipes and

Rubber From Oil

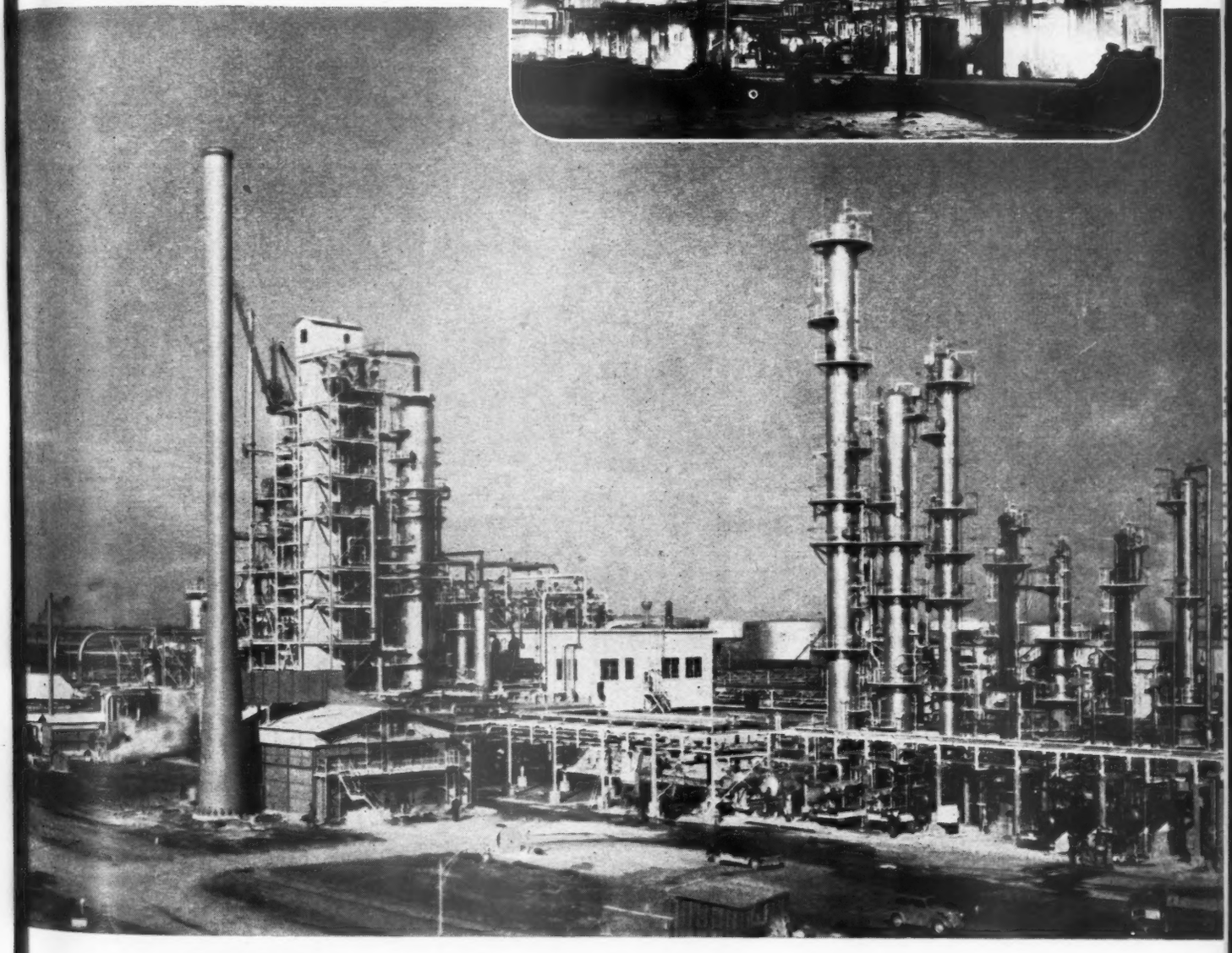
The first proposals in the United States for making synthetic rubber from petroleum were made by refinery chemists in 1931, but it was not until World War II demands became imperative that processes were perfected and put in large-scale use. U. S. production of synthetic rubber jumped from 8,000 tons in 1941 to a peak of 820,000 tons in 1945. Last year, though not up to wartime levels, production came to an impressive 478,000 tons.

Flow diagram of Shell's Montreal plant.



NEW CAT CRACKER BY McKEE

● Engineering and construction of this compact new Catalytic Cracker and its integrated facilities were recently completed by Arthur G. McKee & Company for Shell Oil Company of Canada, Limited.



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pumps to detect any concentration of inflammatory vapors. If such should exceed 60 per cent of the lower explosive limits, an alarm is set off instantly and all mechanical operations are automatically shut down in that part of the plant.

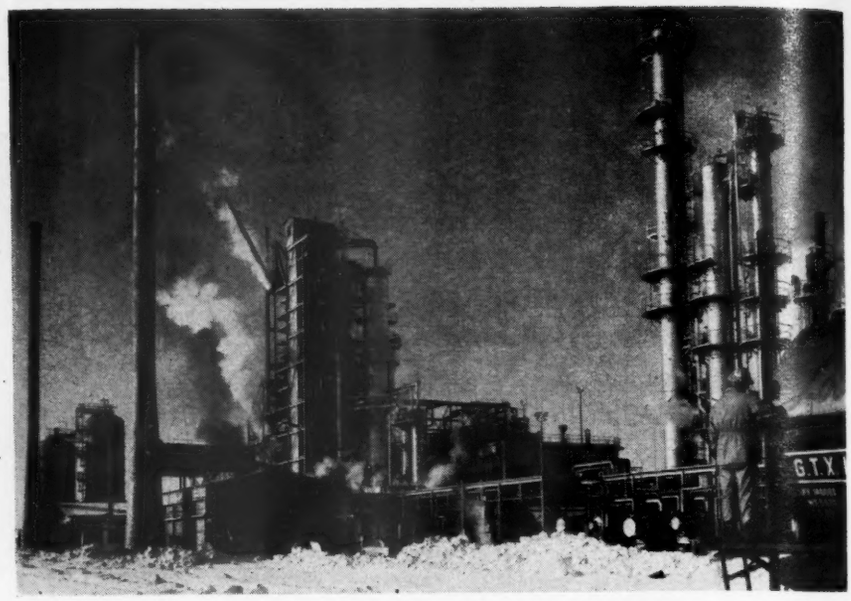
The gas detector draws its samples of air by copper tube from the pumps and pipes and passes them over a hot platinum wire, one of a pair that constitutes a twin-tongued taste-testing device. One platinum tongue is sealed in a cell of pure air; the other is exposed to the air samples drawn from the pipes and pumps. Both carry an electrical current that varies when the wires get hotter. The platinum wire reponds to the air it samples. Combustible gases burn when they contact the hot platinum and create substantial heat in the wire. That, in turn, changes the electrical current and activates an alarm system and automatic control for stoppage of the machinery.

Even without those elaborate precautions the Shell Montreal East refinery achieved an accident frequency rating of 3.97 for 1950. That accounted for the number of accidents per million man hours worked and the severity rate of 0.05 expressed the number of days lost per thousand man hours. The big plant stood well below the average frequency rate of 6.14 for 22 refineries of like proportions in Canada and the United States and earned the Certificate of Achievement issued by the National Safety Council.

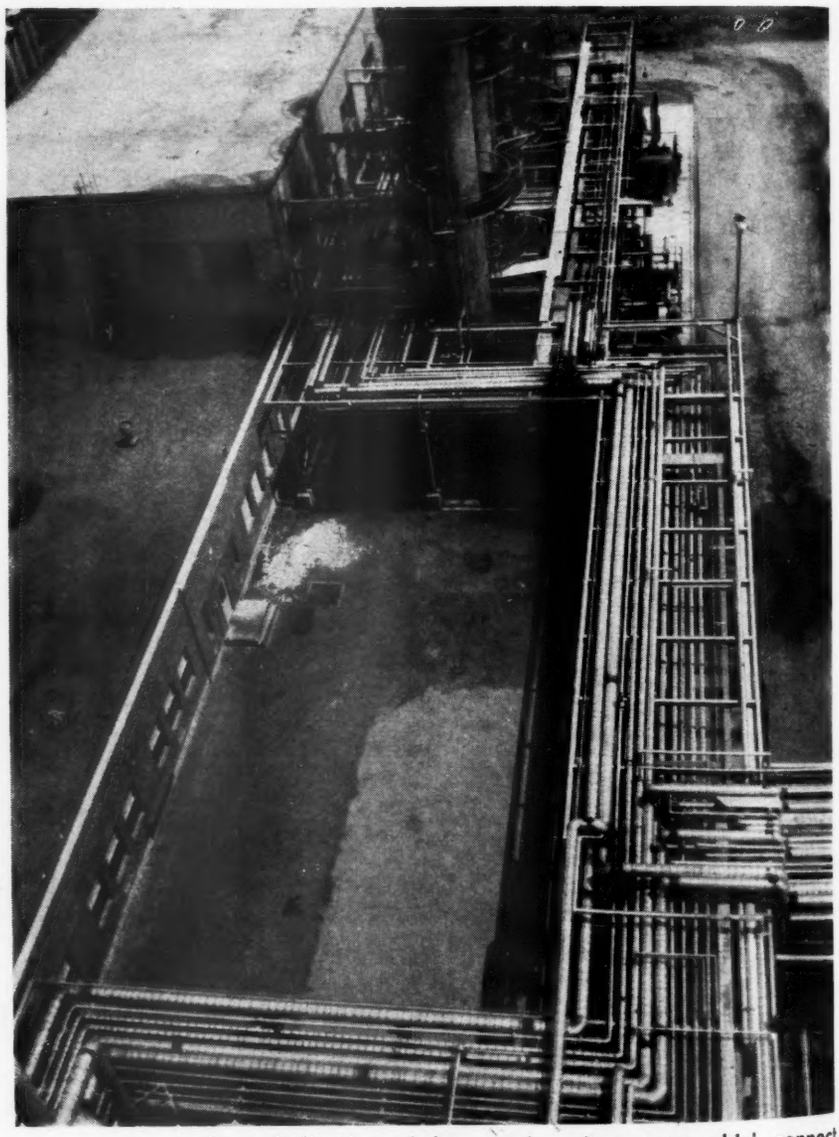
George (Jock) Davidson, of World War II association with the Stanlow Refining Centre on the Manchester Ship Canal and formerly with major Shell operations at Tampico, Aruba and Wood River, Illinois, outlined for The Petroleum Engineer the particular advantages and economics of the cat-cracking unit, as designed and built for the Montreal East refinery, of which he is manager. Its capacity, he explained, is 10,000 bbl daily fresh feed (75 per cent flashed distillate; 25 per cent gas oil) at 55 per cent conversion, without recycle.

"Inclusion of a vacuum flashing unit has made possible the extraction from types of crude available—by ordinary distillation—of gas oils with maximum boiling point of 1000 F, against the former 700 F limit," Davidson stated. "This, in turn, has cut the residual charge to low level thermal cracking from about 45 to 50 per cent of each barrel. The difference is left as a charge for the catalytic cracking facilities."

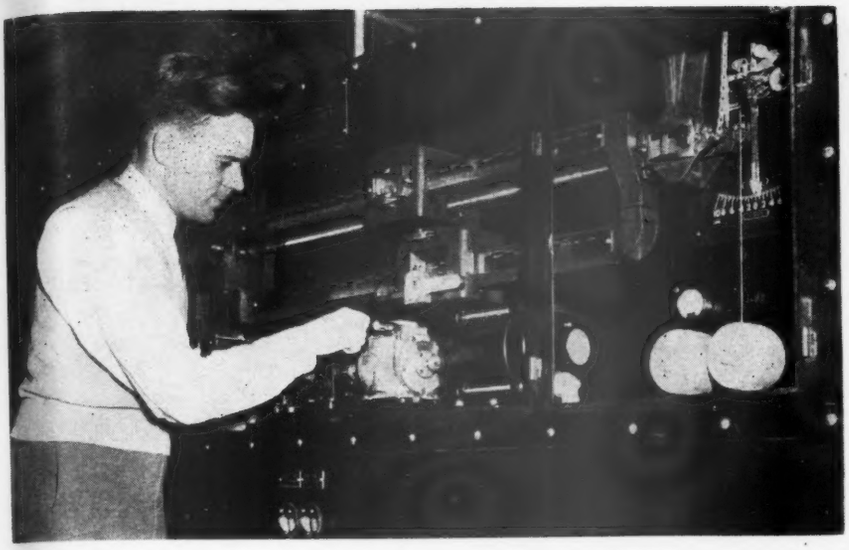
He stressed the following exceptional features of the cracker: Complete heat balance, no preheater or catalyst coolers being provided; oil



New units of Shell's expanded Montreal East Refinery are seen above. Left are the catalyst loggers and vacuum flashing plant, taller large structure in middle is catalytic cracking unit. At right are towers of light ends treater.



Some indication of the complex pipe routes which connect units of Shell's Montreal East Refinery may be seen in this photograph.



This % Proportioneers, Inc. % equipment in the new in-line blending plant adds tetraethyl lead, dye, and stability promoters to motor gasoline. Equipment draws tetraethyl lead from a tank containing 100,000 pounds of material; weighs and adds this lead to the motor fuel continuously and so accurately that weight of tetraethyl does not vary one pound in 100,000.

E. H. Tedford, engineering manager, checks one of the large pumps at the Montreal East refinery.

injection directly to the catalyst bed and elimination of the reactor grid; the utilization of stripper steam to carry spent catalyst to the external stripper; isolation of stripper vapors from the reactor and fractionator; improvement of shape factors by swaged vessels. Large capacity centrifugal type compressors and air-blower are uncommon in Canada.

A new microspheroidal synthetic alumina catalyst, circulating at the rate of 13.5 tons per minute, is being used in the expanded operation, producing higher octane ratings than natural catalyst and eliminating the necessity for electrical precipitators, because of careful size gradation of the catalyst.

Reactor temperature is 925 F; that of the regenerator 1100 F; feed 400 F. Thus the unit is in heat balance and does not require feed preheater or catalyst cooler. Heat required by reactor and stripper is about 77,000,000 Btu per hour and is supplied by 7,350 lb per hour of coke burning in the regenerator, which is transferred by the circulation of catalyst. The top of the stripper is 118 ft above grade; the regenerator is 100 ft high and the reactor 73 ft.

Each of two high-speed centrifugal compressors is of 10,000 rpm. One compresses gas from 5 psi to 60 psi; the second from 60 psi to 300 psi. The compressor control system utilizes a pneumatic speed transmitter originated by Shell Development Company for regulating the speed of each machine, a device that controls compressor speed within less than 0.5 per cent.

New techniques and systems have been designed to improve product quality and closer process control. Narrow span suppressed range pressure and temperature controllers make for fractionating column efficiency; all fractionating columns now being

Shift supervisor of catalytic cracking and related operations, Sam Houston checks over the control readings with Percy Shanks who operates the vacuum flasher unit.

It is a far cry from farming on the Gaspe Coast, but Laurence Dumville left that life four years ago to join Shell. Now third operator No. 2 topping plant, he checks levels and temperatures in the distillation columns.

Two more units of the refinery are seen here on the east side of the site. Right is No. 2 topping plant, which provides a second unit for initial breaking down of crude oil into "fractions." In front of it is the solutizer treating plant, which literally scrubs and washes sulfur compounds out of gasoline. The "hump" of pipes in foreground allows for expansion and contraction of pipe.

Tank trucks are loaded at Shell Oil of Canada's Montreal East refinery.

equipped with pressure instruments that work 50 psi pressure. Temperature spans are 5 deg. Narrow span temperature controllers also are supplied for the critical points of cat cracker vessels.

Pneumatic speed transmitters on turbine drives for blower and gas compressors, originated by Shell, are used at Montreal for demonstrably better control. Two shell viscometers are employed for automatic blending of fuel oils from residuals.

An automatic gasoline blending system makes possible the continuous blending in a single line of the 6 hydrocarban components of gasoline, tetraethyl lead, dye and inhibitor and then routes the finished product direct to ship loading and to loading tanks, for cars and trucks. All operations are controlled from the blending house. Each of the sextet of hydrocarbons is automatic-controlled at a rate predetermined by laboratory formulation and analysis. A special calibrated Magnabond transmitter flashes messages up to 2500 ft to recording instruments. Each receiver is equipped with a very accurate remote index setting device and that transmits back to a remote controller located in the flow transmitter. That, in turn, regulates a valve in close proximity, so there is little or no time lag in the change of flow according to the message dictated.

Among the newer features, also, is the system of recovery of up to 95 per cent propane, almost totally eliminating ethane therefrom.

The regenerator unit for the cat-cracker is 26 ft, 8 in. in diameter, 63 ft long and weighs 115 tons. The cracker is equipped with an elaborate shutdown system. All vital elements (except air-blower and air stream to the regenerator) are blocked in the event of process emergency. If the air system fails anywhere, the air-blower

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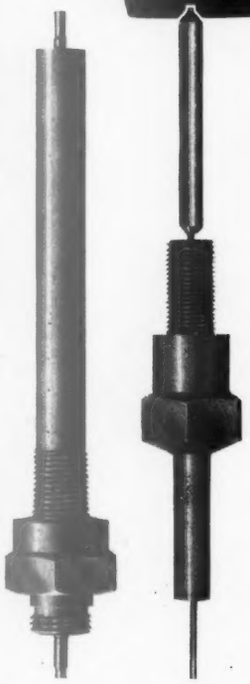

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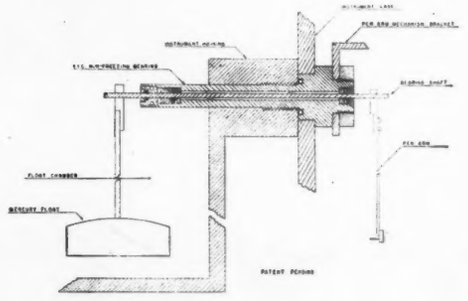

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and air stream cease functioning, as well as the whole system. All devices do not stop instantaneously, but each in proper sequence.

Extreme weather conditions have called for the housing of most operating equipment, such as pumps, exchangers, etc. That, in turn, has posed the safety problem that has been met by the network of explosibility alarms —18 stations throughout the catalytic cracking structure. An analyzer on the air inlet to the control room functions continuously, with a separate alarm system. Should the pressuring air become contaminated with combustible materials, the unit not only sounds an alarm, but stops the pressurizing fan.

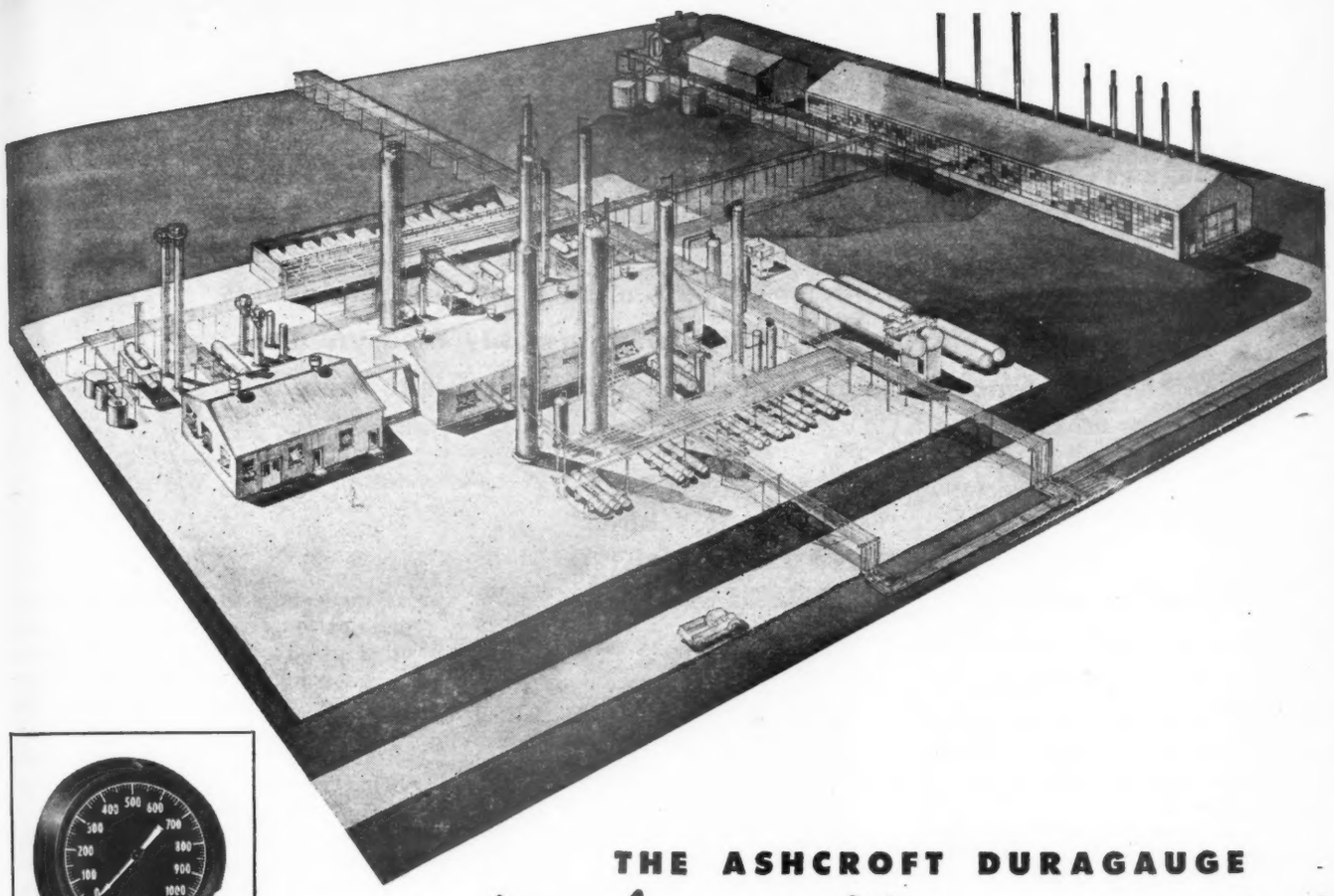
Other new developments introduced by Shell's Measurement and Control Committee included a conventional manometer type of flow meter for replacement whenever necessary, to eliminate cumbersome sealing, tracing, and surging; and a D.P. cell, a differential pressure transmitter unit, which exerts pressure through instrument opening, measured by a thin metallic diaphragm, in turn activating by pneumatic connection to recording unit. Another innovation is the roto-sleeve variation of rotameter, for measuring heavy substances, such as pitch and for use in measuring catalyst slurry.

To furnish the intense heat required in processing operations and to produce steam power requires the consumption of from 4 to 5,000,000 cu ft of gas and about 45,000 gal. of fuel-oil daily. Every hour about 24,000 gal. of water from the St. Lawrence River are converted to live stream.

The new refinery units requisitioned 6368 tons of structural and plate steel; 75 miles of pipe; 24 miles of copper tubing, 65 miles of electrical conductor wire and cable, and 20,200 tons of concrete.

More than 300 invited guests, most of them carried from Montreal proper by a fleet of buses and including press delegations from the metropolis and other cities of the Dominion, heard addresses by Canadian Finance Minister Douglas-C. Abbott and the Mayors, respectively, of Montreal and Montreal East, W. M. V. Ash, president of the Shell Oil Company of Canada Limited, and Mr. Davidson, the Montreal East Refinery Manager. The several speakers emphasized the patent advantages to Canada's national economy of the Shell expansion program, with its greatly stepped-up and broadened production. Each extolled the comprehensive safety measures adopted for the safeguarding of life, limb, and property against accident.

* * *



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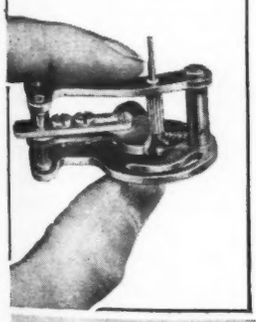

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Diesel Oil Cold Tests and Method for Cloud Point Determination†

Capillary viscosimeter is useful in determining cloud points of dark oils as a continuation to viscosity measurements; the standard cloud point test is not applicable to these oils.

Y. C. YOUNG*

Cold Tests for Diesel Oil

CONSTRUCTION improvements in the diesel engine have resulted in a constant extension of its already wide use. Today, it is used not only as a power unit for stationary equipment but also for mobile units on land, sea, and in the air. From this, it may be seen that it is necessary to determine the characteristics of diesel oil at low temperatures to simulate what may happen under actual working conditions. Among those, who have endeavored to solve this problem, Hagemann and Hammerich[1] first proposed a test for the determination of the filterability of diesel oil at low temperatures using a filter of copper mesh. Later on, Marder and the author[2] devised a simpler and more practical apparatus for this determination. With the above modifications, Hagemann and Hammerich then devised a new form of apparatus, which is now in use as a standard testing apparatus in Germany[3]. The determination of the filterability of diesel oil is a measure of the temperature at which the precipitate in the oil due to cooling begins to stop the filter. The test is carried out in accordance with practical operating conditions of the diesel engine as nearly as possible. The result is intended to show the lowest usable temperature of the oil, below which the feed to the engine would be cut off.

The filterability of a cold oil is influenced by many factors, such as the condition of the precipitate, the feed pressure of the oil, the kind of filter used, etc. None of these factors are involved in the pour point or the cloud point test[4]. The following experiment might be taken as an illustration of the inadequacy of the cloud point test in an extreme case. A sample of diesel oil is mixed with 1 per cent of ceresin, an amorphous waxy material. Before and after the addition of ceresin the corresponding cloud points are below — 30 C and + 5 C respectively, while their corresponding limiting temperatures of filterability test are below — 30 C and — 15 C respectively (Table 1) . The temperature difference between the cloud point and the filterability test of the oil in the presence of ceresin is thus shown to be 20 C. It must be observed that if too low a figure is specified for the minimum usable temperature of an oil, then its cetane value and volatility might be adversely affected.

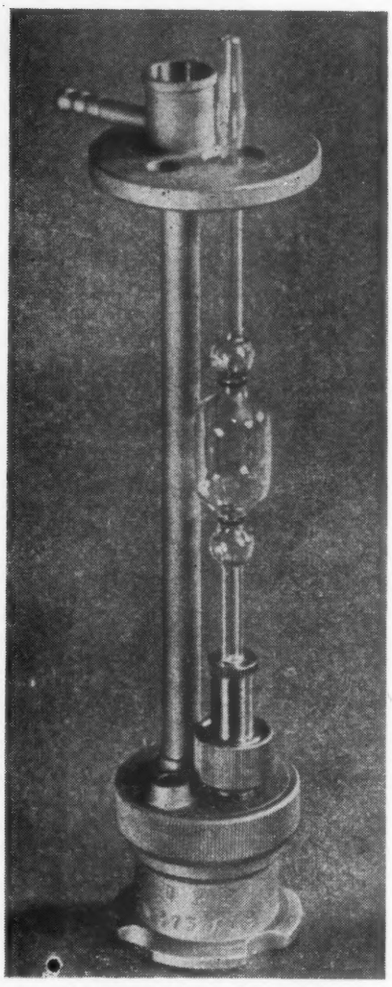

FIG. 1. The Vogel-Ossag viscosimeter.

Of the pour and the cloud point tests, the latter gives results nearer to the filterability test. Obviously all results depend upon the condition of the precipitate in the oil as well as other factors mentioned. For a laboratory, where the facilities for making the filterability test are not available, a cloud point test is evidently preferable to the pour point test. During World War II the author used the cloud point test as a control for the usability of diesel oil in the colder regions in China to meet with different local climate conditions.

According to the ASTM standard (D 97 - 47) the cloud point test is intended for use only on oils that are transparent in layers 1½ in. in thickness. This requirement is beyond the degree of transparency of many diesel oils. To overcome this difficulty,

TABLE 1. Comparison of cold tests for diesel oil.

No. of sample	Diesel oil origin from	Pour point[1] °C	Cloud point[2] °C	Limiting temperature of filterability test[3], °C
1	Petroleum	below —30	below —30	below —30
2	Sample 1 mixed with 1% ceresin	below —30	+ 5	—15

[1] ASTM standard method
[2] The new method described
[3] Marder and Young's apparatus

†Experiments were carried out in the Institute fuer Mineraloel- und Braunkohlenforschung an der Technischen Hochschule, Berlin, Germany.

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bleaching of the oil has been proposed, although this may affect its composition. For example, the paraffin content in the oil may be also adsorbed by treating with active carbon to remove the coloring matter.[5] Certainly some diesel oils, such as those of lignite or bituminous-tar origin, could hardly be bleached without radically changing their compositions. To solve this difficulty, van Wijk[6] proposed a method for the determination of the cloud point of dark oil by measuring the transmittance of infra-red radiation by the oil at various temperatures. The following method described is another means of making this determination which is simple and needs no special equipment. It is carried out in a capillary viscosimeter and done as a continuation to the usual viscosity measurement but at lower temperatures.

Determination of the Cloud Point of Dark Oil

1. Principle and Apparatus Used. The principle of this method is based upon the fact that during cooling, as soon as any precipitation or separation occurs in the oil, the viscosity of the oil will be abnormally influenced. This abnormal change in viscosity is taken as an indication that the corresponding temperature is the cloud point of the oil. The testing may be carried out in any type of capillary viscosimeter. The author prefers the use of Vogel-Ossag viscosimeter[7] for this test, because it is quicker and easier for the control of the testing temperature, and gives accurate results for this determination in a comparatively short time. This test is applicable to any kind of diesel oil and its like, irrespective of whether it is dark or transparent.

The general features of the Vogel-Ossag viscosimeter (Figs. 1 and 2) are as follows: The capillary of the viscosimeter is cemented into a metal sleeve that screws into the cap of the oil reservoir, into which a thermometer is dipped for measuring the temperature of the oil during testing. To the top of the capillary a glass hand-operated suction pump is connected for sucking up the oil when making tests. The whole apparatus is immersed in an unsilvered Dewar flask containing alcohol with solid carbon dioxide added intermittently as a cooling medium. The temperature of the alcohol is generally kept equal to, and not over 0.1 C lower than, the testing temperature. By raising and lowering the level of the oil in the capillary, the temperature required for testing may be quickly arrived at and maintained constant. The time of flow of a definite amount of oil from the upper mark down to the lower mark on the capillary, multiplied by the capillary constant, gives the viscosity of the oil. Tests may be made at successive temperatures without disturbing the apparatus.

2. Method of Determination of Cloud Point. Moisture, if present in the sample, should be removed by any suitable method, such as filtration through a dry filter paper or by filtering through calcium chloride. The time of oil flow is measured in the Vogel-Ossag viscosimeter as described above. The oil is tested from higher to lower temperatures at intervals of about 2 C. The cooling medium is kept as near to the testing temperature as possible. At every testing temperature, the time for the oil to flow through the capillary is measured three or four times. If the cloud point has not been reached these values should be equal. When the cloud point is reached, however, i.e., when the precipitate begins to appear in the oil, the time of the oil flow will then change in succeeding tests even though the testing temperature is held constant. The temperature at which this abnormal change in time of oil flow begins is taken as the cloud point of the oil.

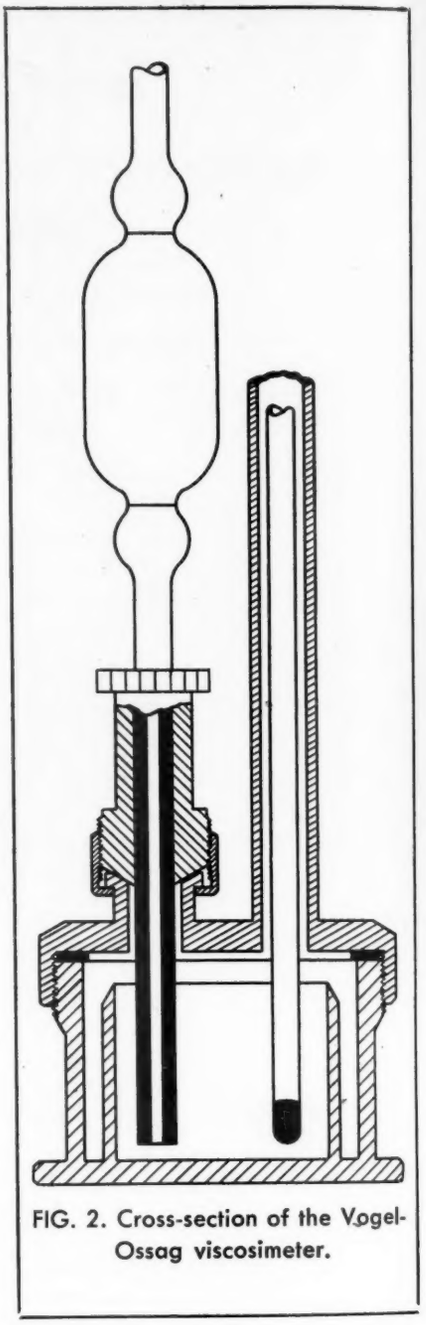
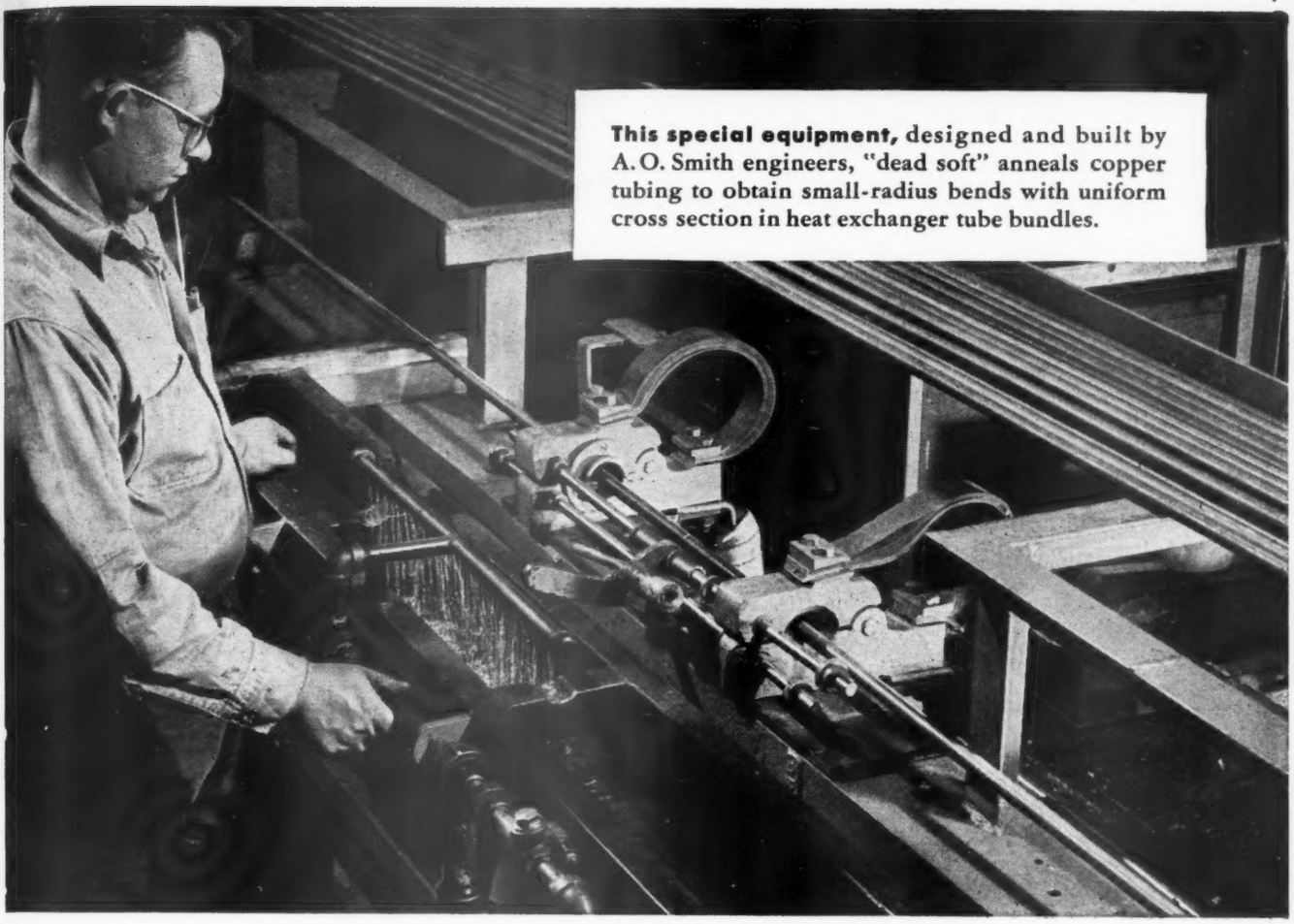


FIG. 2. Cross-section of the Vogel-Ossag viscosimeter.

TABLE 2. Determination of the cloud point of various oils by means of capillary viscosimeter.

The Vogel-Ossag viscosimeter used has a capillary constant k=0.158

No. of sample	Diesel oil origin from	Testing temp. °C	Time of oil flow in viscosimeter, Test number 1 Min.	1 Sec.	2 Min.	2 Sec.	3 Min.	3 Sec.	4 Min.	4 Sec.	Cloud point °C
3	Fischer-Tropsch Synthesis	+10		30.3		30.3		30.3		30.3	
		+ 4		35.3		35.3		35.3		35.3	
		+ 2		37.3		37.3		37.3		37.3	
		+ 1.5		44.0		44.4		43.4		42.3	+1.5
		+ 1			(capillary stopped by precipitate						
4	Petroleum	0	1	9.1	1	9.1	1	9.1	1	9.1	
		− 7	1	33.4	1	33.4	1	33.4	1	33.4	
		− 8	1	38.0	1	38.0	1	38.0	1	38.0	
		− 9	2	2.7	2	2.2	2	2.0	2	1.8	− 9
		−10	2	35.6	2	28.2	2	26.1			
5	Petroleum	+ 4	1	5.9	1	5.9	1	5.9	1	5.9	
		− 5	1	34.6	1	34.6	1	34.6	1	34.6	
		− 6	1	39.9	1	40.1	1	40.6	1	40.8	− 6
		− 7.5	2	5.5	2	6.5	2	6.3			
6	Petroleum	−15	1	11.8	1	11.8	1	11.8	1	11.8	
		−20	1	29.9	1	29.9	1	29.9	1	29.9	
		−23	1	45.4	1	45.4	1	45.4	1	45.4	
		−24	1	57.2	1	56.2	1	55.6	1	55.0	−24
		−25	2	15.2	2	11.1	2	8.4	2	6.6	
7	Low temperature tar of bituminous coal	+10	4	55.5	4	55.5	4	55.5	4	55.5	
		+ 5	7	20.6	7	20.6	7	20.6	7	20.6	
		+ 4	8	3.1	8	5.2	8	11.3	8	24.3	+ 4
		+ 2			(capillary stopped by precipitate						
8	High temperature tar of bituminous coal	− 2	4	17.9	4	17.9	4	17.9	4	17.9	
		− 5	5	26.6	5	26.6	5	26.6	5	26.6	
		− 6	5	54.6	5	56.5	5	59.6	6	2.7	− 6
		− 9	9	0.6	9	23.1	9	40.5			
9	Low temperature tar of lignite	0	1	47.7	1	47.7	1	47.7	1	47.7	
		− 4	2	13.5	2	13.5	2	13.5	2	13.5	
		− 5	2	21.2	2	21.5	2	22.9	2	23.3	− 5
		−11	4	15.0	4	18.7	4	16.1			



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During the experiment, as soon as the abnormal change in the time of oil flow begins, the precipitate in the oil also begins to settle or adsorb on the inner surface of the bulb of the capillary tube, which may be clearly seen through the unsilvered Dewar flask. Moreover, after the abnormal condition begins, the time of oil flow at the same temperature either increases or decreases successively. The variation, however, may be also irregular. This apparently depends upon the condition of the precipitate (Table 2). Any of these phenomena may be taken as an indication that the cloud point has been reached.

The most suitable capillary size of Vogel-Ossag viscosimeter for this determination is that with k = 0.1 to 0.2, where k stands for the constant of the capillary tube in centistoke units (Table 4). The time required for making a determination with such a capillary is usually about half to one hour.

3. **Experimental Data.** The cloud point of seven Diesel oils of various origin were determined by the above stated method. The results are listed in Table 2.

From the data in Table 2, it is evident that the abnormal change of the oil viscosity at the cloud point is very clear.

4. **Comparison of the Cloud Point Determined by the New Method With That by the Standard Method.** Ten samples of diesel oils, which are either transparent or capable of being bleached transparent without any appreciable change in composition, are taken for comparison. The cloud points found by the two different methods are listed in Table 3. Samples 1, 2, 7, 8, 9, 12, and 13 were too dark to be measured by the standard method for cloud point test and are omitted from Table 3.

From the table, it may be seen that the temperatures of the cloud point determined by the two methods are practically equal to each other. The difference between them, if any, is within the limit of necessary accuracy.

5. **Relation of the Capillary Diameter With the Cloud Point.** In order to determine the capillary influence upon the results of cloud point obtained, four samples were tested with different capillary diameters. The results are listed in Table 4.

From the table, it may be seen that the difference between cloud points determined by using different sizes of capillary tubes may be up to 2 C, which is within the limit of accuracy necessary. The capillary with a smaller diameter is more accurate for the determination but takes a longer time, while that with a larger diameter is less accurate. The lower the viscosity of the oil, the smaller the diameter of the capillary that should be used. In general, capillaries of Vogel-Ossag viscosimeter with a constant k= 0.1to 0.2 are most suitable for this determination.

TABLE 3. Comparison of cloud points determined by the new method with that by ASTM standard method.

Number of sample	Diesel oil origin from	Cloud point, °C by the new method	Cloud point, °C by the ASTM method
3	Fischer-Tropsch synthesis	+ 1.5	+ 1.5
4	Petroleum	— 9	— 9
5	Petroleum	— 6	— 6.5
6	Petroleum	—24	—25
10	Petroleum	— 6	— 7
11	Petroleum	—10	— 8.5
14	Petroleum	— 9	—10
15	Petroleum	—20	—23
16	Petroleum	— 1	— 2
17	Petroleum	— 9.5	—10

TABLE 4. Relation of the capillary diameter with the cloud point determined.

No. of sample	Diesel oil origin from	Viscosity at 20°C cSt	Cloud point, °C when capillary constant k= 0.0207	0.0605	0.0816	0.158	0.221	0.794	1.400
10	Petroleum	8.84	— 6	— 6	— 6	— 6	— 6	— 6	— 6
11	Petroleum	2.97	— 8	— 9	— 9	—10	—10	—10	—10
12	Low temperature tar of bituminous coal	4.45	+ 6.5	+ 6.5	+ 6.5	+ 6.5	+ 6.5	+ 4.5	+ 4.5
13	Low temperature tar of lignite	5.02	— 2	— 2	— 2	— 2	— 2	— 3	— 3

TABLE 5. Analytical data of the diesel oils used.

No. of sample	Diesel oil origin from	Sp. Gr. at 20°C	Distillation index	Heating value Kcal./Kg.	Pour point °C	Viscosity at 20 C cSt	Tendency for coking[2] % by wt.	Cetane No.[3]
1	p[1]	0.902	302	9940	—30	10.90	0.84	51
3	f	0.771	271	10490	— 1	3.74	0.00	105
4	p	0.875	281	10170	—11	5.52	0.21	63
5	p	0.840	298	10240	—10	6.12	0.08	75.5
6	p	0.855	256	10110	—37	3.51	0.94	55
7	b	0.970	280	.....	—22	23.4	12.35	21
8	h	1.045	250	.....	—22	10.6	8.74	8
9	l	0.926	276	9530	—12	7.62	8.53	34
10	p	0.860	311	10180	—10	8.84	0.06	70
11	p	0.843	251	10050	—17	2.97	0.70	58
12	b	0.964	264	9390	—14	4.45	4.81	16
13	l	0.871	262	9710	— 7	5.02	6.56	50
14	p	0.854	256	9960	—13	3.18	0.34	55
15	p	0.849	274	10200	—32	4.85	0.29	63 5
16	p	0.875	251	10180	—18	3.04	5.02	45
17	p	0.851	281	10150	—12	4.95	0.17	65

[1] p=petroleum; f=Fischer-Tropsch synthesis; b=low temp. tar of bituminous coal; h= high temp. tar of bituminous coal; l=low temp. tar of lignite.
[2] by Hagemann-Hammerich's method (1)
[3] by Heinze-Marder's method (8)

Conclusion

As a measure of the usability of diesel oil in the cold, the pour point test has less value than the cloud point test. The most practical method of evaluating diesel oil in the cold is the filterability test.

A new method for the determination of the cloud point of diesel oil and similar oils is described. It may be done as a continuation of the viscosity measurement of the oil in a capillary viscosimeter but at lower temperatures. The temperature, at which the viscosity of the oil begins to be abnormal, is the cloud point of the oil. The cloud points of oils of any color, dark or transparent, may be easily determined by this method.

Acknowledgment

The author wishes to express his appreciation to Professor J. E. Myers of the Chemical Engineering Department in Purdue University for his kind assistance in the preparation of this paper. In addition, the author is greatly indebted to the kindness of Dr. G. Egloff of the Universal Oil Products Company, Chicago, for reading the article and for his valuable suggestions.

Appendix

Analytical data of the diesel oils used for experiment are shown in Table 5.

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Percentage Calculations Butane-Propane

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Initial boiling point ..... — 40 F
Final Endpoint ..... + 20 F
Vapor Pressure (Reid) @ 100 F 190 lb

A. M.

A In the opinion of the writers, it is not believed possible to analyze a binary mixture of hydrocarbons by as simple a procedure as an ASTM distillation unless large amounts of experimental data are available. The analysis of any mixture of materials by obtaining boiling point curves or vapor pressures relies on corrections to a true boiling point curve by means of correction factors derived from extensive data. Unfortunately, there is no simple relationship between an ASTM curve and a TBP curve. For each TBP curve, a single ASTM curve may be defined, but a given ASTM analysis may correspond to several TBP analyses. This occurs because the ASTM distillation procedure is an empirical one, and the results obtained depend to a large extent on the particular apparatus, operator, and techniques.

A rather comprehensive study of the relationship between TBP and ASTM curves was made by Geddes (IEC, 33, 795 (1941) it will be noted that the data used in making the correlation were collected for heavy petroleum fractions (gasoline through gas oils) and may not be applicable to binary LPG fractions.

If it is known that the sample contains only propane, isobutane, and normal butane, the weathering test developed by Schaufelberger, Miller, Horn, and Venatta (California Oil World 34, No. 6, 22-3, 25-6 (1941); 35 No. 2, 31 (1942)) may be used to obtain satisfactory results. The correlation depends on accurate measurements of the 15 and 85 per cent points as shown in Fig. 1. The use of this figure is shown in Example 1.

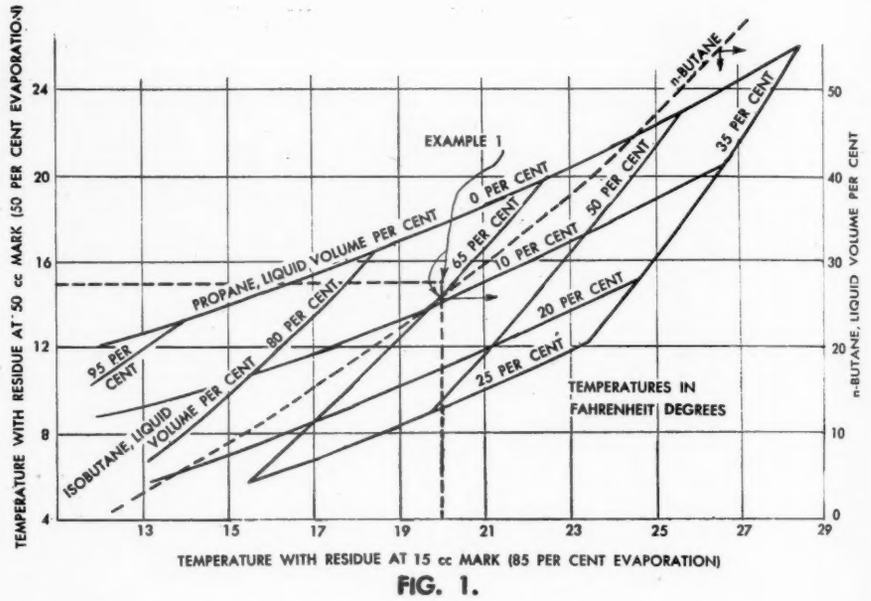

FIG. 1.

A weathering test on a sample composed of butanes and propane shows a temperature of 15 F at the 50 per cent point and a temperature of 20 F at the 85 per cent point. Locating these points on the ordinate and abscissa, respectively, the analysis is seen to be:

Propane	7.5 liquid vol. %
Isobutane	66.5 liquid vol. %
n-butane	26.0 liquid vol. %
	100.0

The experimental accuracy of this method is about ±2.5 per cent, ±1.5 per cent and ±1.0 per cent for propane, isobutane and normal butane, respectively. It will not yield satisfactory results in analyzing for propane contents below 1 per cent or isobutane contents above 95 per cent. The original article lists the correct type weathering tube, thermometers, procedure, etc.

Because both of the methods just cited require more data than those given, a phase equilibrium calculation and vapor pressure calculation were made to determine the magnitude of the butane and propane contents of the sample. These calculations were based on the butane distribution being 50 per cent normal and 50 per cent iso.

For a binary mixture of materials

$$X_2 = \frac{1 - K_1}{K_2 - K_1}$$

a. K C_3 at 1 atmos., — 40 F = 1.72
Kn C_4 at 1 atmos., — 40 F = 0.182
KiC_4 at 1 atmos., — 40 F = 0.310
K C_4 (avg.) = 0.246

$$XC_4 = \frac{1 - 1.72}{.246 - 1.72} = 0.488$$

$$XC_3 = 0.412$$

b. K C_3 at 1 atmos., + 20 F = 3.7
KnC_4 at 1 atmos., + 20 F = 0.805
KiC_4 at 1 atmos., + 20 F = 1.220
K C_4 avg. = 1.00

$$XC_4 = \frac{1 - 3.7}{-3.7} = 1.00$$

$$XC_3 = 0$$

The answers obtained by the above calculations are probably in error by ±30 per cent but do give an idea of the original analysis of the sample.

A. M. Platt
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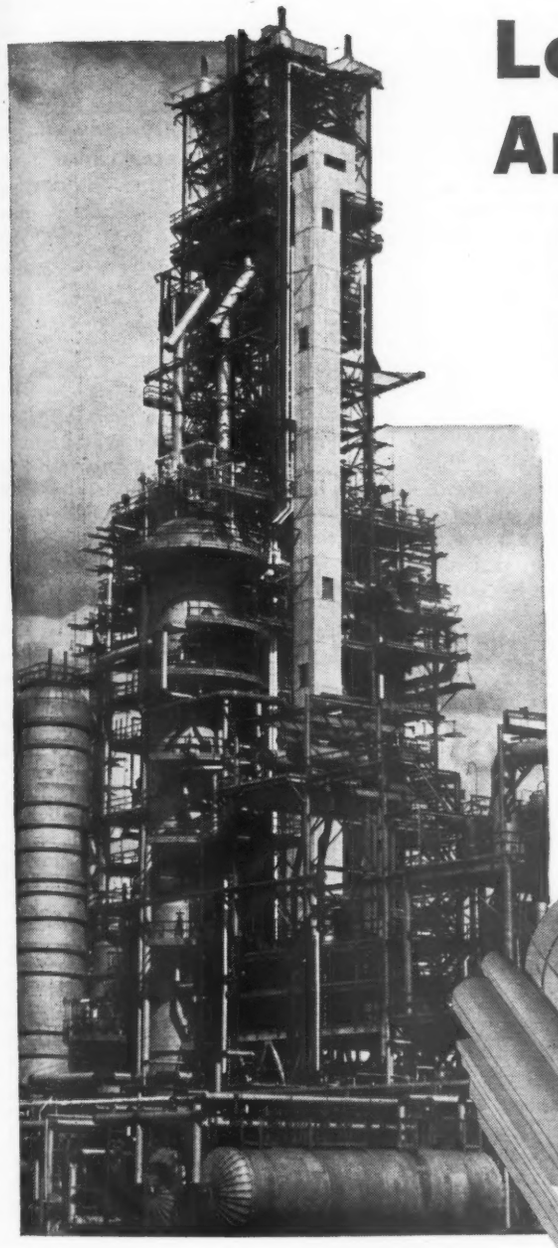

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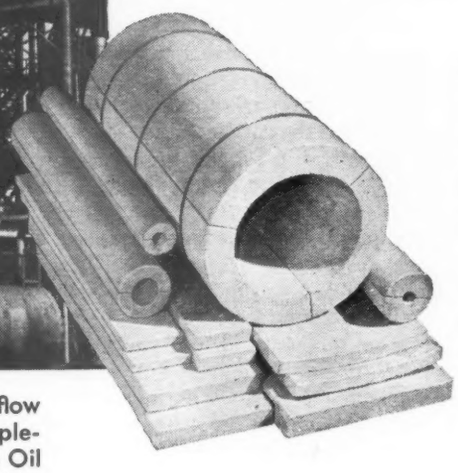
Kaylo Heat Insulation is insoluble in water and incombustible. Its light weight and high strength make it easy to handle and apply.



KAYLO PIPE INSULATION is made to Simplified Dimensional Standards of thicknesses and diameters. Coverings are sectional for tube and pipe sizes ¼" to 12"; tri-segmental up to 23"; quad-segmental up to 41"; K-segmental (18" wide segments) up to 72" in diameter.

KAYLO HEAT INSULATING BLOCK is made in all standard sizes and thicknesses from 1" to 6" for flat surfaces and for vessels larger than 60' in diameter; curved block 18" wide for smaller vessels.

The first major installation of Houdriflow "cat" crackers — a 308-ft. quadruple-reactor catalytic cracking unit — Sun Oil Company's Plant 5 at Toledo, Ohio. The entire catalyst system is insulated with Kaylo Heat Insulation.

SEE OUR CATALOG IN THE REFINERY CATALOG

For complete details on Kaylo Heat Insulation, write Dept. N-175, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

KAYLO® **... first in calcium silicate**

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Properties of Five Types of Greases

Q What are the considerations, specifications, standards, which determine and govern the consistencies of greases destined for services such as: (1) water pump greases; (2) cup grease service; (3) universal joint greases; (4) wheel-bearing greases; (5) "axle" greases?—*O. T. B.*

A Previous to about 1925 automobiles and trucks made use of lubricating greases that were available, consisting largely of cup and fiber greases. As the number of cars on the road increased and more consideration was given to their maintenance it was found that certain lubricating greases gave better service in particular points that did others. Recognizing these facts, some distributers of automotive lubricating greases began to manufacture and market special lubricating greases for specific applications. Such a line included water-pump grease, wheel-bearing grease, universal joint grease, steering-gear lubricant, and chassis lubricant. Following this the motor car manufacturers recognized the wisdom of such a move and, working with lubricating grease manufacturers and others concerned, set up specifications for such specialty products.

While the original specifications for such products were largely empirical, it was found that service tests justified the choice of lubricants in most cases. The present NLGI grading for lubricating greases was adopted in 1939 and the special products in question are generally manufactured to fall within the consistency range of one of the NLGI grades.

Information on the specific products in question will follow. Mention must first be made however, of multi-purpose lubricating greases that have been developed to satisfy the demands of all of the special applications. Most of these multi-purpose lubricating greases are manufactured in a consistency to fall within a No. 2 NLGI range, that is 265 to 295 worked penetration at 77 F.

Water-Pump Grease. It was found that heavy grades of cup grease gave adequate lubrication for this service and also that such products served as a seal and would not work into the cooling system. One of the early specifications issued by a motor car manufacturer set a worked penetration limit of 165 to 225 at 77 F for a water-pump grease. Most of the subject greases now marketed have worked penetration limits falling within a No. 4 NLGI range, that is, 175 to 205 at 77 F.

Cup Grease. Experience has shown that a medium grade cup grease is satisfactory for most service, that is a No. 2 or No. 3 NLGI grade (265 to 295 and 220 to 250 worked penetration respectively). Heavier grades are difficult to force into a bearing with a screw cup and softer grades may feed too readily. If the cup grease is to be applied with a gun however, a softer grade corresponding to a No. 1 NLGI range with a worked penetration of 310 to 340, is desirable.

Universal Joint Grease. In order to withstand the centrifugal force in a Universal Joint a lubricating grease with a cohesive and adhesive nature is required. Such characteristics are obtained by manufacturing a product with a long tough fiber and with a reasonably heavy oil. The above qualities dictate that the product has to be soft enough to pump at low temperatures. It was found that a lubricant with a consistency of 300 to 330 would handle well in cold weather and yet would stay in the universal joint. Most suppliers now produce this lubricant in a No. 1 NLGI grade with a worked consistency of 310 to 340.

Wheel Bearing Grease. A wheel bearing grease should be of such consistency that it will not work down and throw off the bearing. Although it is true that seals should prevent such throwoff these are not always dependable. On the other hand, any very heavy or stiff lubricating grease will have a tendency to channel and thus fail to lubricate. As a compromise it was found that a properly made wheel bearing grease of No. 2 NLGI grade, (265 to 295 worked penetration) was satisfactory in service.

The government and many other users, however, depend not only upon a consistency specification but also on an actual wheel bearing test run at 220 F on a CRC wheel bearing tester. This testing machine serves to verify the wisdom of the consistency range given above, for if a No. 2 grade of lubricating grease is softened in penetration to a No. 1 grade (310 to 340 worked penetration) it will seldom pass this test.

Axle Grease. Axle grease is a product that works down readily, in fact many axle greases will have a worked penetration twice that of the unworked. As axle greases are seldom applied with a gun they can be quite stiff is an unworked state. A worked axle grease, if left undisturbed, will set back to almost the original consistency. This "setting up" is quite rapid and thus after axle grease is forced from the zone of motion it will become heavy enough to act as a seal to prevent loss of lubricant.

Most of the axle grease that is marketed will fall within a penetration range of 130 to 160 unworked and 300 to 330 worked. This range satisfies the above conditions in that it can be applied readily and yet will not soften to too great an extent. Where this type of lubricant is used as a curve grease, the consistency may be 30 points softer so that it can be easily spread with a paddle or brush.

C. J. B. and R. R. M.

Cleaning Oil Storage Tanks

Q Please discuss the most efficient methods for cleaning and conditioning a 5000-bbl crude run tank, to put it into shape for the storage of gasoline, kerosine, or other light oil finished product or fraction.

M.C.N.

A After the tank has been adequately drained, vented, and purged, long accumulations of basic sediment and water on the tank bottom should be removed. In many instances tank cleaning crews find it expedient to "muck out" tank bottoms manually with shovels and wheel barrows. In many instances it is necessary to remove a sheet or plate from the tank above the bull ring and bulldoze the accumulated deposits into a pit dug in the ground. The pit should be approximately 4½ ft deep and the sludge should be covered with at least 2 ft of earth.

Upon completion of "mucking out" operations, the interior tank walls can be cleaned by spraying on a solution containing a self-emulsifying solvent mixed with a light distillate, preferably kerosine. After all interior tank shell surfaces have been wet down with this solution, a four-hour soaking period should be allowed. If observations show the soil to be soft all the way through to the metal surface of the tank, a fire hose rinse of approximately 125 lb nozzle pressure can then be employed to effect final soil removal. Any accumulation of cleaning or rinsing solution can be removed from the tank bottom by either placing a fire hose extension from a sump pump to the low point in the tank floor or squeezing them out the tank opening.

Reliable manufacturers of industrial cleaning compounds have developed tank cleaning procedures to a high degree of efficiency and their information is usually offered as part of their service. It is strongly recommended that they be consulted to assure optimum advantages being gained from the solvents being purchased. These companies take into consideration factors such as the type of oil, sweet and sour crude, and other such problems that may form interfering accumulations.

Vincent E. Bowes.

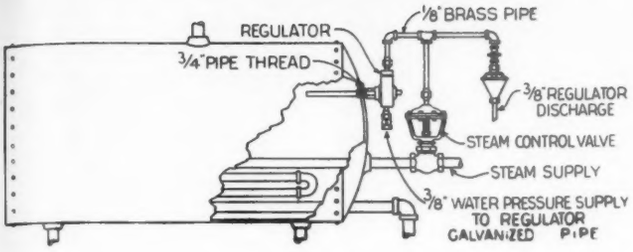


FIG. 1

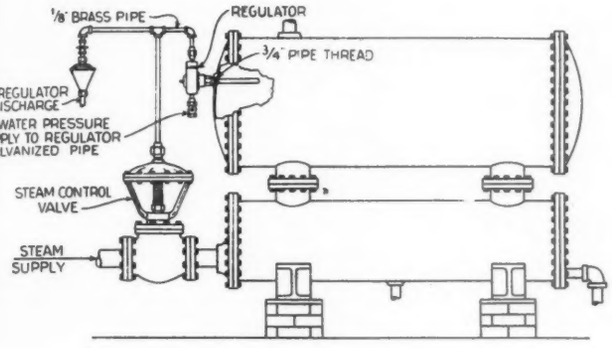


FIG. 2

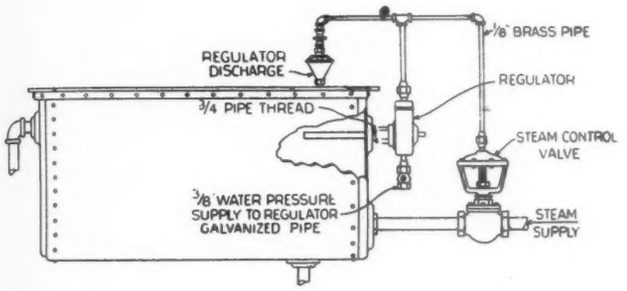


FIG. 3

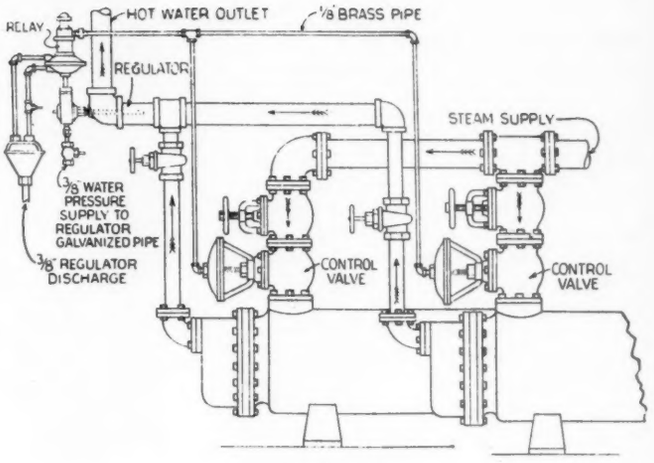


FIG. 4

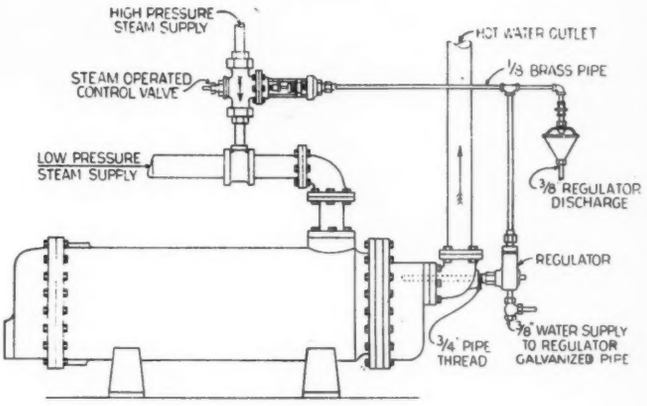


FIG. 5

HOT WATER PIPING SYSTEMS

W. F. SCHAPHORST

Five piping arrangements for hot water installations are shown herewith.

Fig. 1 shows how to pipe up a hot water storage tank by means of a hot water temperature regulator and a steam control valve. The regulator is hydraulically operated. Simply connect to service water system at the point marked "3/8 in. water pressure supply to regulator." It operates in this way: When the temperature of the water reaches the desired point, the metallic expansion tube, which is inserted into the tank, expands and permits the water pressure to pass through the regulator to the diaphragm valve and shuts off the steam. When the temperature decreases the tube will contract, thereby discharging the pressure from the diaphragm valve and turning on the steam.

This temperature control is highly accurate and sensitive. It will operate easily within two degrees variation and can be adjusted to maintain the temperature where it belongs.

Tanks equipped with a control system of this kind operate at full capacity because the control valve stays wide open until the desired temperature is reached, and then it closes completely.

A regulator of this type will operate the largest steam or other control valve, at any commercial pressure, with as little as two degrees variation in temperature.

It is readily adjusted to act at any temperature up to 300 F.

Fig. 2 shows how to pipe a hot water heater and storage tank. The operation of the regulator is precisely the same as described above for Fig. 1.

Fig. 3 shows how to pipe an open tank. It will be observed that the piping arrangement for Figs. 1, 2, and 3 is practically the same in each instance.

Next we run into a slightly more complex problem, Fig. 4, which shows how to pipe two hot water generators, both control valves being operated by one hot water regulator. An extension of this method will take care of any number of control valves.

Finally Fig. 5 shows how to pipe a hot water generator using high pressure supplementary steam for heating. It is assumed here that the low pressure steam supply need not be regulated at all because it is insufficient in quantity. Some high pressure steam must therefore be added automatically from time to time, as is done by this system. * * *

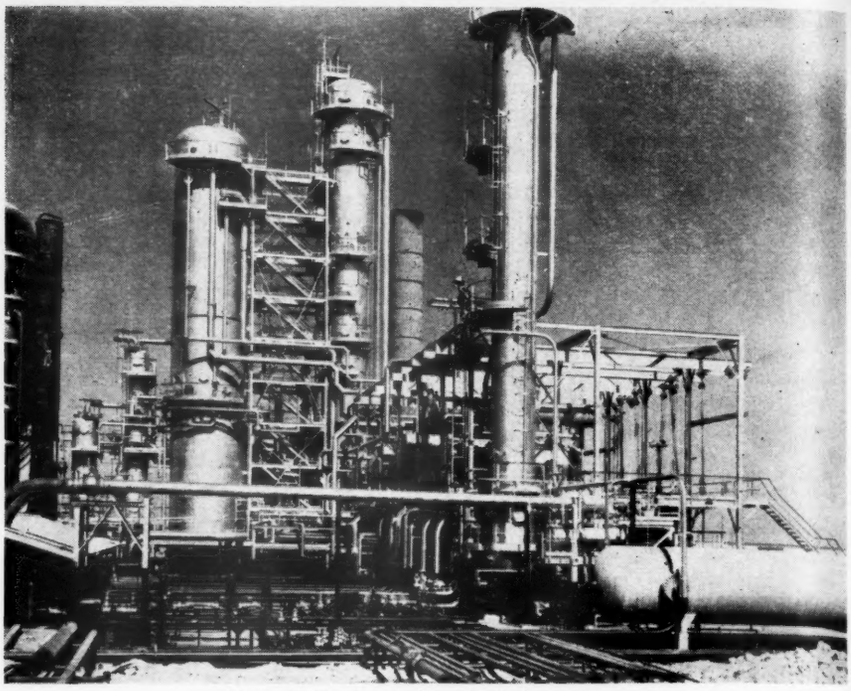
NEWS

API Refining Meet Is Scheduled for May, 1952

W. L. Stewart, Jr., vice president for refining, American Petroleum Institute, has announced that the 17th midyear meeting of the Division of Refining will be held in San Francisco, California, May 12, 13, 14, and 15, 1952. The St. Francis Hotel will be headquarters for the meeting. Stewart is executive vice president of Union Oil Company of California, Los Angeles. This will be the first midyear meeting of the Division of Refining to be held on the Pacific Coast.

An elaborate technical program is being planned—the Program Committee under the chairmanship of W. M. Holaday, director of Socony-Vacuum Laboratories, New York. Technical sessions are tentatively planned on a number of basic refinery subjects. Offers will be approved at the next meeting of the program committee, scheduled for the first week in November. Offers on the following subjects are welcomed and should be addressed to these committees:

1. Corrosion and corrosion prevention —E. Q. Camp, Humble Oil and Refining Company, Box 3538, Baytown, Texas.
2. Electrical equipment—L. M. Goldsmith, The Atlantic Refining Company, 260 South Broad St., Philadelphia 2, Pennsylvania.
3. Analytical research—E. L. Baldeschwieler, Standard Oil Development Company, P. O. Box 51, Linden, N. J.
4. Waste disposal—L. Mittelman, Tide Water Associated Oil Company, 79 New Montgomery St., San Francisco, California.
5. Training personnel—T. M. Rushing, The Texas Company, 135 East 42nd St., New York 17, N. Y.
6. Automotive fuels and lubricants—T. B. Rendel, Shell Oil Company, 50 West 50th St., New York 20, N. Y.
7. New refining processes—W. T. Gunn, American Petroleum Institute, 50 West 50th Street, New York 20, N. Y.



New distillation unit at Bahrein refinery.

Battenfeld Survives Flood

Despite the worst flood in Kansas City's history and a raging 4-day fire that ravaged the surrounding area, Battenfeld Grease and Oil Corporation's Kansas City plant has resumed full scale production. Radio, television, and press released many erroneous reports that the company was destroyed by fire. After the smoke had lifted, however, the following facts were evident:

1. Battenfeld's full production facilities escaped damage. Also completely undamaged were the office, laboratories, tank farm, power plant, repair shops, shipping facilities, and some raw material and container storage facilities. All personnel escaped injury.
2. The fire destroyed a warehouse one block north of the main plant. The warehouse was filled with containers and some raw materials. A second leased warehouse, situated three blocks north of the main plant and filled with containers, was also destroyed by the fire.

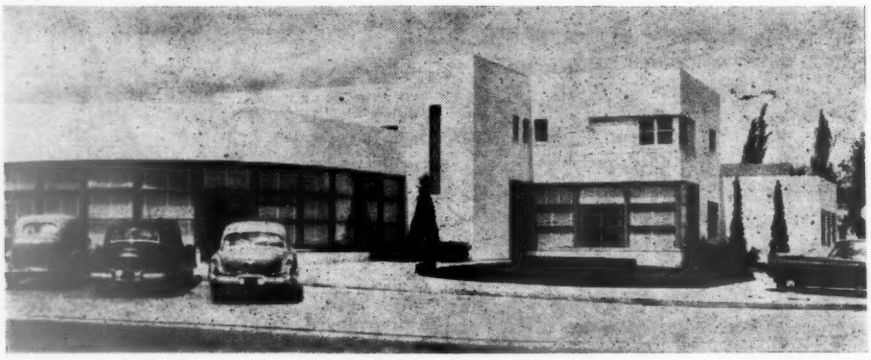
New Crude Unit at Bahrein

The Bahrein Petroleum Company announces the successful operation of a new distillation unit at Bahrein.

The first run of eight months, which has just been completed, resulted in the processing of 17,570,000 bbl of crude, or an average of over 72,000 bbl per day.

The new unit was designed to operate in conjunction with an existing vacuum distillation unit and produce a wide range of closely fractionated straight run products from Saudi Arabian crude. Design work by The Lummus Company was essentially complete in little over one year. Construction was carried out by International Bechtel, Inc.

The Crude still is a preflash type of distillation unit in which whole crude is first fractionated at a pressure of approximately 60 psig. A light gasoline of from 180 F to 270 F end point is taken overhead from the preflash column; two naphtha side cuts are taken from the preflash column and used for gasoline blending, reformer charge, or jet fuel manufacture.

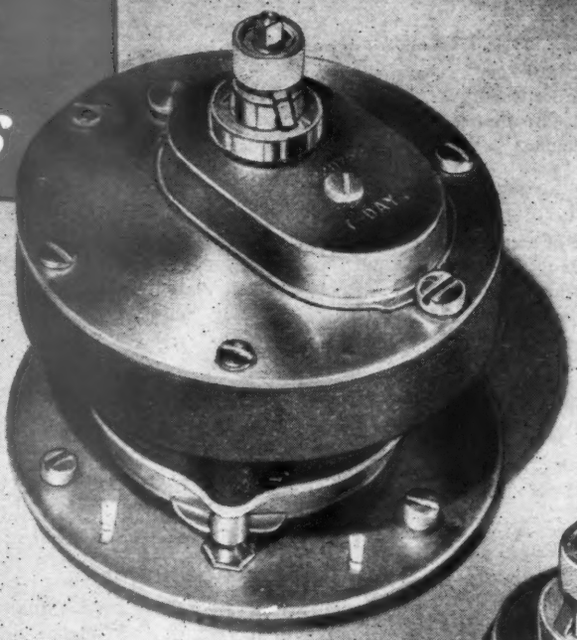


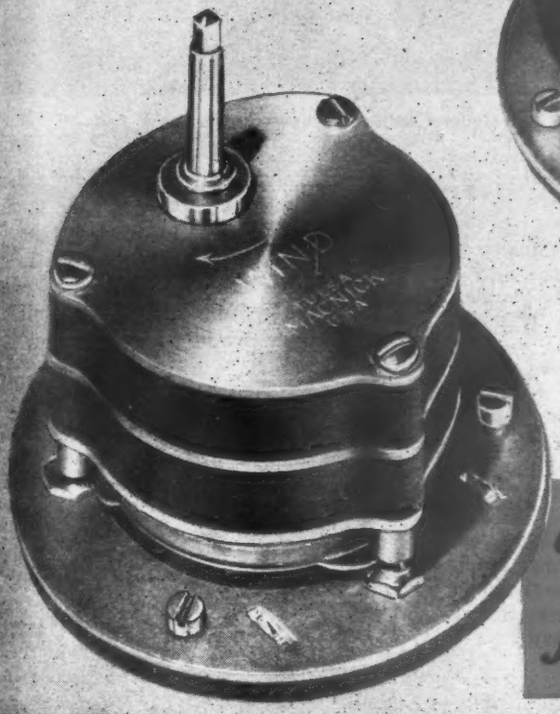
Continental Carbon Company's new laboratory for research on carbon black. Situated in Amarillo, Texas, the laboratory is designed to extend the company's facilities for the improvement of existing processes in the production of carbon black as well as experimental work on new products in the field. Witco Chemical Company is sole distributor of Continental Carbon.

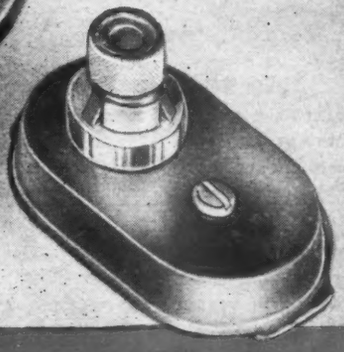
Skelly Oil to Double Gasoline Plant Expansion

Skelly Oil Company is proceeding with the engineering, design, and purchase of materials and actual construction to more than double the capacity of the Velma gasoline plant and to build a booster station about six miles Southeast of the main Velma plant for the delivery of casinghead gas. The plant and booster station will process a total of 73,000,000 cu ft per day of gas. Plans contemplate the possible conversion of the mentioned booster station into a natural gasoline absorption plant at the time the company's field growth warrants such conversion, which is expected to be in the immediate future.

Mighty Midgets



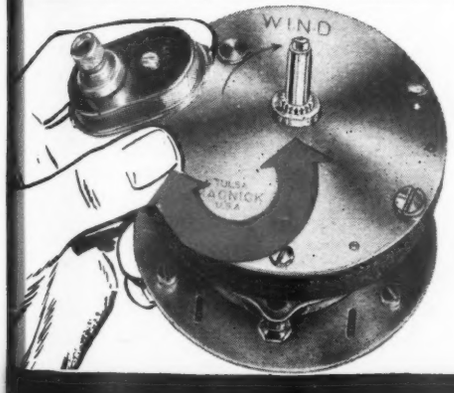




SHOWN ACTUAL SIZE

Left to right: Rockwell 24 hour wind and 8 day wind midget mechanical drives with rotation-converting Turret that, on the eight day model, permits one basic drive to be adapted to as many as 11 different speeds.

dependable, convenient drives for Meters, Controls, Recorders



THE TURRET ON TOP *does the trick!*

The above illustration shows how Turrets lock onto the chart arbor of the eight day model to change rotation speeds. The eight day drive is basically 24-hour rotation. Turrets are available for chart rotation times of 2, 3 4, 6, 8, 12 and 48 hours; 3, 7 and 8 days.

THE **MOST** CHART DRIVE IN THE **LEAST** SPACE

Rockwell Midget Chart Drives fill the need for compact, powerful mechanical drives in instruments where space is at a premium. They are strongly constructed with cases of die cast aluminum, gears mounted in phosphor bronze bearings and an escapement case made of stainless steel and clear plastic. This escapement snaps into place without tools and is readily replaceable.

Rockwell Midgets wind through the chart arbor. They snap into a separate mounting ring only 3¼″ in diameter which may be positioned on bosses or adaptors to fit any instrument case.

This combination of small size, versatility of application and precision construction makes Rockwell Midgets the most economical drives to use. It will pay you to specify them in instruments made by any manufacturer.

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Southwestern Petroleum Company's new quarters.

Lubricant Company Moves Into New Addition

Southwestern Petroleum Company of Fort Worth, Texas, has moved into a new addition, which has almost doubled the size of its office building at 917 North Main. (See photo above.)

The company's directors have named the newly-enlarged structure the E. H. Beall Building, executive vice-president J. F. Canning announced in honor of the founder and president of the specialty lubricant and asphalt roofing material manufacturing concern. The new addition, built at a cost of $35,000, extends 85 ft in front of the former structure and brings the building to the edge of North Main. The builder was the E. M. Moore Construction Company.

Sulfonate Output Up

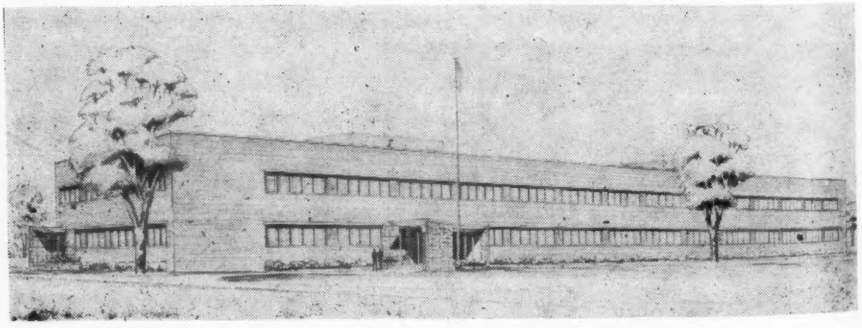
Additional facilities for the manufacture of oil soluble sodium sulfonates went on stream recently at Shell Oil Company's Martinez refinery. Shell Chemical Corporation will continue to market the product, announced L. V. Steck, vice president.

The increased production will help to relieve the tight supply of sulfonates, demand for which is strong, particularly as additives for heavy-duty lubricating oils. Sulfonates in oil prevent deposits from forming in motor engines, valves and pistons—here the action of sulfonates is much the same as that of a synthetic detergent in a washing machine. Shell's Martinez refinery near San Francisco was one of the first to manufacture sulfonate as a primary product from petroleum.

Ohio Oil Announces New Expansion Program

An expansion program increasing the capacity of The Ohio Oil Company's Robinson, Illinois, refinery by 33 per cent has been announced. Construction of new refining units and modification of existing facilities to boost the plant's capacity from 30,000 to 40,000 bbl per day will begin as soon as materials can be obtained, it was further announced. The program is expected to require 18 months to complete.

New units to be built include a 6000 bbl per day coking unit, and a 7000 bbl-per-day catalytic reforming unit. Additions and modifications will also be made to the plant's present crude unit, fluid catalytic cracking unit, light ends area, power house, and product storage facilities. In addition, refined products terminals will be constructed at Toledo, Ohio, and Mt. Vernon, Indiana, to receive products by pipe line from the Robinson refinery. The company has received certificates of necessity from the Defense Production Administration.



Construction is to begin immediately on Universal Oil Products Company's proposed new office building in DesPlaines, Illinois. The company has acquired a 54 acre tract of land, which is large enough to permit the addition of a laboratory, pilot plant, and other facilities at a later date.

Burmah Oil Installs New Units in Refinery

Burmah Oil Company has announced that it is installing several new units at its Chauk refinery in Upper Burma designed to shorten waste residue from existing 30 down to 6 per cent. When completed in December 1952, the refinery will distill and refine 3000 bbl per day of crude oil to produce gasoline, high and low grade kerosines, diesel oil, furnace oil, and waxes.

Included in the proposed projects are: Tube still distillation unit with atmospheric and vacuum stages designed to handle 3000 bbl crude oil per stream day; a wax extraction plant complete with chillers and presses; a wax sweating plant and bauxite filtration plant for refining the wax, and a wax moulding and packaging plant.

Italian Refinery Underway

Construction on Condor's 27,000 bbl a day refinery at Rho, Italy has begun, with completion date set for the end of next year. Included are: 30,000 bbl atmospheric distillation unit, a 15,000 bbl catalytic cracker, recovery, separation and purification units, as well as refining and blending plants, and an 82,000,000 gal storage unit.

New Extraction Process

The Dow Chemical Company has announced the development of a new process for the extraction of aromatic concentrates for aviation gasoline, benzene, toluene, and xylenes from petroleum. The new process, named UDEX, was developed in cooperation with Universal Oil Products Company, Chicago. According to Dow spokesmen, the UDEX process effects a substantially complete separation of the aromatics necessary for the production of synthetic rubber, explosives, and other products essential to the military and civilian economy. The recovery of these aromatics from wide-boiling petroleum naphthas is exceptionally high, and the UDEX product can be separated by distillation to produce benzene and toluene of high quality.

Phillips Chemical Hits New Safety Record

Phillips Chemical Company employees in the butadiene section of Plains plant at Borger, Texas have completed 1,000,000 man-hours without a lost-time accident. Both butadiene and synthetic rubber are manufactured by Phillips at this government-owned plant.

The safety period, which began on December 18, 1950, is the third outstanding safety accomplishment in the plant's history. On December 24, 1947, this plant completed its first million man-hours without a lost-time injury. This record continued unbroken until February 25, 1948, when one accident resulted in two lost-time injuries. From that date to January 27, 1950, the butadiene section employees worked 3,000,000 consecutive man-hours without a lost-time accident, a first in the history of Phillips plants.

A. B. Leonard is manager of the Plains plants. L. M. Fairman, industrial relations superintendent, is in charge of the safety and fire protection program; O. D. Henderson is safety supervisor, and W. C. McKinney is fire marshall.

Shell Engineers Open New Scottish Plant

Four Shell Oil Company engineers have been sent to Grangemouth, Scotland to start-up the new multi-million dollar synthetic ethyl alcohol plant there. One of the factors in the British chemical industry's expansion program, the new plant is operating under Shell license. It uses the direct hydration process worked out at Shell Development for Shell Chemical Company's Houston plant. Engineers were C. R. Nelson, M. L. Courter, and M. E. Stromsmoe, from Shell's Emeryville, California refinery, and R. B. Hanning on loan from Shell Chemical Corporation's Houston ethyl alcohol plant.

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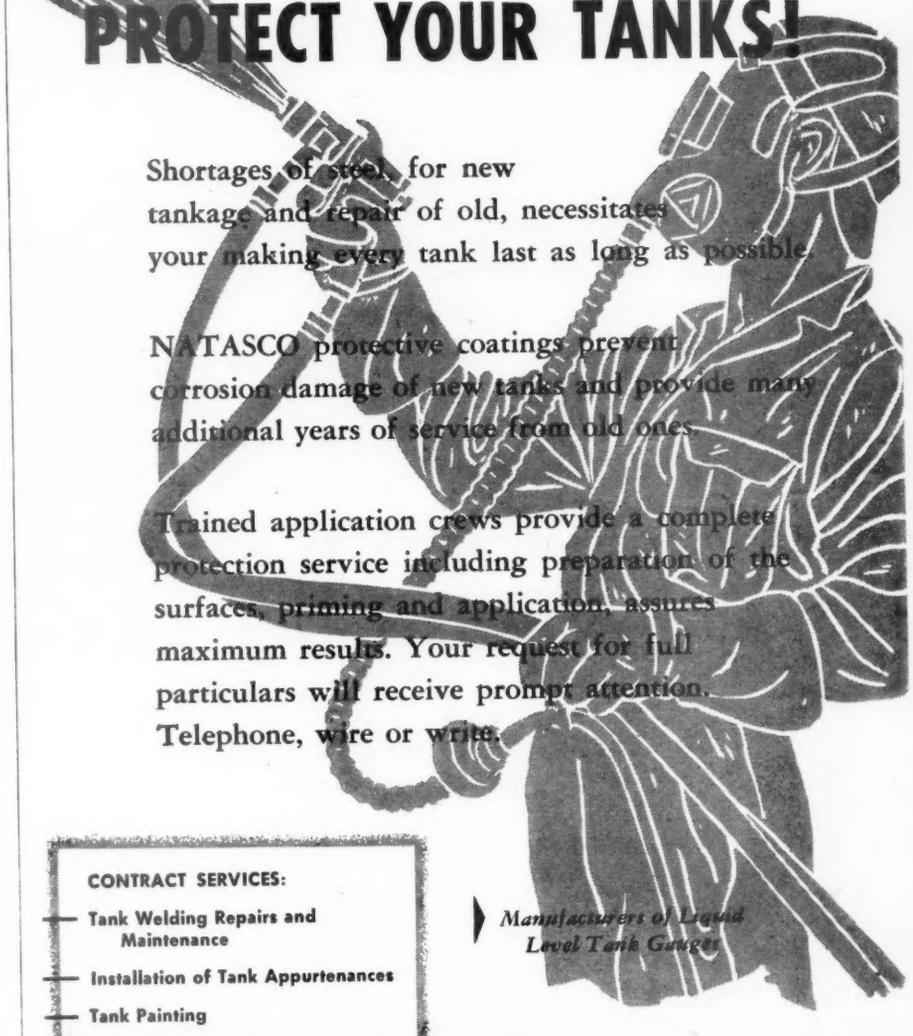

Shortages of steel, for new tankage and repair of old, necessitates your making every tank last as long as possible.

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Chile's First Refinery to Be at Concón

Chile's state-controlled petroleum monopoly, ENAP (Empresa Nacional del Petroleo), with headquarters at Santiago, which is charged by the government with "the exploration, exploitation, and refining of petroleum in Chile," has announced its plan to construct the country's first refinery at Concón. The plant, including a thermal cracking unit, will have a processing capacity of 15,000 bbl daily. The cost is estimated at U. S. $4,000,000.

The site chosen is virtually in the center of the southern republic and, so, is within easy reach of vital consumption points.

As virtually all of the machinery and materials employed in the Chilean petroleum industry are of American origin, the bulk of refinery requirements will come from this country (U. S.), with a small proportion possibly to be brought from Europe. The Empresa Nacional del Petroleo being a direct subsidiary of the Corporación de Fomento de la Producción de Chile, United States bidders may contact the New York buying agency of the Corporación in the Equitable Building, 120 Broadway, New York City.

Crude petroleum from the only deposits thus far actively exploited in Chile, which are in the extreme south Province of Magallanes, fronting upon the Straits, is of the paraffinic type with gravity range between 41 and 43 API, containing less than 0.1 per cent sulfur. The present deposits have produced only since 1949. Within the three years the production has been as follows:

1949	55,400 bbl
1950	630,800 bbl
1951 (6 mos)	322,700 bbl

The first natural gasoline plant is in process of installation in the Magallanes drilling area and its operation and production will be markedly increased when the Concón refinery is completed and starts to function. Distribution of refinery products throughout Chile will be by tank freight-cars and tank trucks over the railways and highways.

Pipe lines adequate to move the crude from the wells to the port of embarkation have a capacity of 15,000 bbl daily. The chief pipe line, 68½ miles in length and 8⅝ in. in diameter, is fully protected, covered, and buried. It has one pumping station. The terrain being virtually horizontal, the line is without gradient.—H.C.P.

New Refinery to Use Canadian Crude Oil

Plans for construction of a $7,000,000 oil refinery near the cities of Duluth, Minnesota and Superior, Wisconsin, were announced recently by International Refineries, Inc. of Minneapolis, Minnesota, which will own and operate the facilities. H. M. Baskerville, president of the corporation, said that the refinery, to be situated in Carlton County, Minnesota, will have a capacity of 11,500 bbl a day. It will adjoin the Interprovincial Pipe Line, which runs from Edmonton, Alberta, Canada, to Superior, Wisconsin. The construction has been approved by the Petroleum Administration for Defense and a certificate of necessity issued by the Defense Production Administration.

The refinery is expected to be completed and in operation by October of next year, Baskerville stated. Products of the refinery will be premium and regular motor gasoline, distillate fuels, range oil, diesel fuel, and fuel oil. The entire output of the refinery has been sold to Western Oil and Fuel Company, of Minneapolis, of which Baskerville is also president.

The refinery will be one of the first in the United States to process Canadian crude oil, Baskerville stated. The company has entered into a contract with Imperial Oil, Limited, an affiliate of Standard Oil Company (New Jersey), for the required crude oil supply. The crude oil will be transported a distance of 1,150 miles from Alberta, Canada, to the refinery by Interprovincial Pipe Line Company, Limited, and its subsidiary, Lakehead Pipe Line Company, Inc.

The refinery will be constructed by, The Lummus Company, New York City, as designed and licensed by Standard Oil Development Company, an affiliate of Standard Oil Company (New Jersey).

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AN OLDTIME RECIPE FOR LONG-LIVED PIPE LINES

A recipe that waterworks and gas distribution engineers have used for over a century is: *specify cast iron pipe.* Refinery engineers have used it, too—with good success—for run-down, water and gasoline lines—for fire protection systems—salt water disposal—condenser and cooling coils.

No other pipe, at reasonable first cost, offers comparable resistance to both interior and exterior corrosion. No other pipe, in its price range, is as economical in the end. Available with bell-and-spigot, plain end and flanged, or with standardized mechanical joints. Cast Iron Pipe Research Association, Thomas F. Wolfe, Engineer, 1015 Peoples Gas Bldg., Chicago 3, Illinois.

CAST IRON PIPE
FOR LONG LIFE AND ECONOMY

Howard H. Hannon (right), refinery worker, describes a $1500 idea he had to Robert L. Minckler, president of General Petroleum Corporation. The hopper device improves the efficiency of the gasoline-making catalytic "cracker" on which Hannon works at General Petroleum's Torrance refinery. The idea netted him $1500 cash under the company's suggestion plan. The hopper takes test samples of the catalyst from the unit without costly interruptions of its operation.

Exhibitions Planned for Chemical Exposition

Three hundred-eighty-one leading concerns will occupy all available exhibit space on four floors of Grand Central Palace, New York for the 23rd Exposition of Chemical Industries, November 26 to December 1 of this year.

Prominent in the display will be a great deal of processing equipment that has been developed or re-designed to meet demands for greater capacity per ton of mass and per cubic foot of capacity. There will be new manufacturing materials, in the raw and in application to new machinery, and new and more efficient machinery and equipment to meet increased specifications required by intensified operation.

The Exposition, as heretofore, is under the management of the International Exposition Company of New York, Charles F. Roth, manager.

Synthetic Detergents Plant Enlarged

Plans for a $1,500,000 expansion of facilities for production of synthetic detergent materials have been announced by T. S. Petersen, president of Standard Oil Company of California.

Petersen said Standard will build the additional facilities at its Richmond refinery for its chemical subsidiary, Oronite Chemical Company. They will provide capacity to make Oronite's detergent alkane to meet present and future needs of the soap and synthetic detergent industries. Detergent alkane is used largely in the manufacture of synthetic detergents for the household market. Oronite is the largest supplier of this important detergent intermediate.

Stripping Plant Planned for Illinois

National Petrol-Chemical Corporation, and National Distillers Products Corporation, have announced plans to build a $38,000,000 plant to manufacture products from natural gas. Negotiations are underway for the purchase of a 500-acre site near Tuscola, Illinois on which to build the plant.

Propane, butane, ethyl chloride, natural gasoline, and other products will be extracted, and then the gas will be returned to the line. About 400,000,00 cu ft a day, or 30 per cent of the gas would be consumed.

UOP PLATFORMING UNIT for

STANDARD OIL COMPANY OF CALIFORNIA

Standard Oil Company of California is installing a 10,000 b/d UOP Platforming Unit at their El Segundo refinery in response to the urgent defense requirements for increased production of benzene and toluene.

This Platformer, when constructed and placed on stream, will economically and efficiently fulfill about 15% of the increase in production of these aromatics which was requested of the industry by the Petroleum Administration for Defense.

Standard's Platforming Unit has been designed to operate on a "blocked out" basis, which enables it to be rapidly converted from aromatics to motor fuel operation. This versatility is still another reason why Universal's Platforming Process has met with such ready acceptance by refiners throughout the world.

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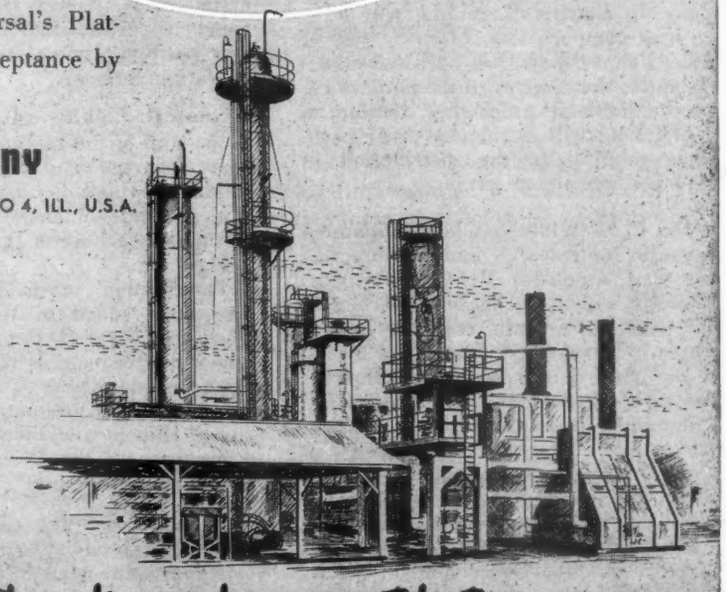
Universal Service Protects Your Refinery



The market belongs to the refiner who serves it best

—PERSONALS—

▸ **Arthur B. Allyne** has been appointed assistant general manager of Honolulu Gas Company and Pacific Refiners Limited, both of Honolulu, Hawaii. Allyne holds a degree in Chemical Engineering from the California Institute of Technology. From 1927 to 1937 he was chemist for the Southern Counties Gas Company of California. In 1937 Allyne joined the staff of the California Railroad Commission and was appointed senior gas engineer in 1940.

During the recent war Allyne was on duty with the U. S. Army Chemical Warfare Service. Returning from the service in 1945 he joined the staff of Ebasco Services, of New York City, as gas engineering consultant, a position he has held to date. Officials of Honolulu Gas Company and Pacific Refiners, Limited, are E. E. Black, president and A. E. Englebright, vice president and general manager.

▸ **Russell W. Hall, Jr.,** University of Oklahoma graduate student in physics, has been granted an Ethyl Corporation fellowship. Dr. George L. Cross, OU president, said the grant is for a year's research on the spectroscopic properties of tetraethyl lead and related compounds.

Hall, whose home is in Houston, Texas, will work with Dr. J. Rud Nielsen, OU research professor of physics and international authority in the field of molecular structure and spectroscopy. He expects to complete requirements for the Ph. D. degree by June 1952.

▸ **C. E. Davis** of New York City has been appointed deputy director of the refining division of the Petroleum Administration for Defense. The former vice president of the Shell Oil Company, in charge of refining, will serve without compensation. **Alton S. Lutz** of Erie, Pennsylvania, has been named assistant to the director of the natural gas production and processing division of PAD. Lutz will be in charge of problems relating to the distribution of liquefied petroleum gas.

▸ **Dr. P. C. White** has been appointed manager of research and development for Pan American Refining Corporation. He will make his headquarters at the company's main research laboratories in Texas City, Texas.

Dr. White joined Pan American from the research department, Standard Oil Company (Indiana), Whiting, Indiana. He entered the petroleum industry in 1935. In 1950, he was appointed division director, fuels and special products division at the Whiting Laboratory.

M. C. Hopkins, previously coordinator of research and development, has assumed the duties of technical director. In this position, Hopkins will be directly responsible for all phases of chemical engineering work. **Dr. J. E. Kasch** advances from assistant director to associate director. Working directly under Hopkins, Dr. Kasch will be in charge of process development, process design, and economics.

Hopkins was graduated from Rice Institute.

▸ **C. L. Crenshaw** has joined Berry Asphalt Company at Stephens, Arkansas, as superintendent of the refinery there. He had been general manager of Shallow Water Refining Company for the past 12 years. Before joining Shallow Water Refining, Crenshaw was general manager for Lake Refining Company.

▸ **Sheldon T. Dahl** has been named West Coast manager of American Cyanamid Company's industrial chemicals division and plastics and resins division. Dahl joined the company when the S. T. Dahl Company was acquired by Cyanamid in 1948.

Herbert G. Pratt has been promoted to manager of the San Francisco office of the industrial chemicals division. He also joined American Cyanamid when the S. T. Dahl Company was acquired by that company.

▸ **David S. Frank,** refinery manager of the Pure Oil Company's Toledo, Ohio refinery, has been transferred to Chicago, Illinois, where he will be assistant manager of the refinery technical department. He had been superintendent and manager of the Toledo refinery for the last six years. **Hal H. Dronberger** was named to succeed Frank, moving up from general superintendent, a position he has held since 1947. Succeeding Dronberger is **William S. McConnor,** superintendent of construction and maintenance. **Victor H. Trumpy** was named superintendent of operations, a new position. He was formerly general operating foreman.

▸ **James R. Calkins** was recently added to the staff of the research and development department of Sun Oil Company at Marcus Hook, Pennsylvania. Calkins is a graduate in chemical engineering of the Massachusetts Institute of Technology.

Three other recent graduates have also been added to this department. They are: **Peter S. Hepp,** chemical engineering graduate of the University of Pennsylvania; **Oscar A. Klamar,** chemical engineering graduate of the University of Illinois, and **Eleanor A. Greiner,** a graduate of the Drexel Institute, in chemical engineering.

▸ **J. D. Nelson, Jr.,** compressor plant foreman, Humble Oil and Refining Company, was transferred from Stratton, Louisiana, district to Pickton gas plant as gas plant superintendent.

Dr. John E. Kircher

▸ **Dr. John E. Kircher,** of Chicago, Illinois, widely known industrial chemist, has been named manager of Continental Oil Company's petro-chemical department. His headquarters will be in the executive offices in Houston.

Dr. Kircher will be vice president and a director of Sharples-Continental Corporation, Baltimore, manufacturers of base products for detergents; vice president and director of Petroleum Chemicals, Inc., and a director of Continental Oil Black Corporation, which is now constructing a $1,500,000 plant near Lake Charles, Louisiana, for the manufacture of high abrasion carbon black from oil. Continental Oil Company is interested in all three corporations.

Dr. Kircher holds a B.A. degree in chemistry from Culver-Stockton College, Canton, Missouri, and a Ph.D. degree in chemistry from the University of Missouri.

▸ **Roy M. Teel** has been appointed assistant to the manager of the natural gasoline department, George P. Bunn, Phillips Petroleum Company. **H. R. Legatski,** who has been superintendent of operations, has been named project development engineer for Phillips Chemical Company, a subsidiary of Phillips Petroleum. In this newly created job Legatski will evaluate the technical aspects of projects for the company. **Louis P. Sumpter** succeeds Legatski as superintendent of operations.

In other changes **W. L. Culbertson** has been appointed chief engineer in charge of the engineering division succeeding Teel; **C. R. Ringham** has been appointed director of the section of coordination and analysis of the engineering division succeeding Culbertson; **L. H. Moore** has been appointed superintendent of the division of contracts and settlements, with **R. H. Clark** to direct the settlement section; **H. R. Markley** has been named assistant to Sumpter in charge of plant operations, and **W. L. Phillips** has been appointed western district superintendent at Odessa, Texas, to succeed Markley.

Manila Refinery Proposed

Caltex Oil Company has requested permission from the United States and the Philippine governments to build a proposed 16,000 bbl a day refinery in the Manila area. The plant would be used to process Sumatra crude.

Crankcase Oil Control in Vertical Engines

OIL WIPER PISTON RINGS AND PISTON DESIGN AS RELATED TO 2-CYCLE AND 4-CYCLE ENGINES

C. J. KREMER, JR.*

OPERATORS and designers alike agree that the problem of crankcase oil control in both 2- and 4-cycle vertical engines continues to be somewhat of an enigma. As a result, both wiper rings and piston drain arrangements have become so complex that decision regarding the type of either is increasingly difficult. It has repeatedly occurred to the writer that the entire concept of present day oil control is almost directly reversed as regards oil wiper rings and piston design.

Let us consider several of the more popular and most widely used types of oil control or oil wiper piston rings.

From Fig. 1 it will be noted that each of these types is composed of several components: (a) The wiping edge, which is simply a reduced bearing surface for the purpose of increasing the unit pressure so as to cut through the oil film; (b) a collecting and distribution channel for the purpose of gathering the oil scraped from the cylinder wall and guiding it to the drain or return holes; (c) the drain notches that conduct the surplus oil to the back of the ring so that it reaches the drains or returns provided by the piston.

One of the primary requirements of a good oil scraper ring is that it have sufficient tension in itself to break down the oil film. Reduced contact edges are provided to convert this tension to high unit pressure on the wall. Obviously, any and all cutting away of the ring's cross-sectional area only tends to defeat this principle. In addition to the loss of natural ring tension, these cut-away sections and notches weaken the ring at concentrated areas and, thereby, increase the possibility of permanent distortion during installation or handling. A wiper ring that does not perfectly fit the cylinder wall is really little better than no ring at all. Its tension is falsely and unevenly distributed and bypasses are provided wherever it fails to contact the liner properly.

If the ring were free of channels and cut-away sections, it would be less susceptible to distortion. Its natural tension would be greatly enhanced and this tension would be more stabilized and more evenly distributed. Depending upon the amount of cutting and notching required to do a satisfactory job, the ring becomes expensive as compared to an ordinary plain snap type. This added cost burden must be repeated each time a ring requires replacement.

Actually, only one of the above-mentioned components, the scraping edge (a), is necessarily a function of the ring. The collecting channel (b) and the drain notches (c) can be transferred easily and permanently to the piston itself.

As a wiper ring groove is usually provided with some form of drain or oil return holes, the collecting channel would be the only net addition to the piston groove design. The channel could be added to the piston in a simultaneous machining operation with the ring groove at no added cost.

It must also be borne in mind, that no matter how expensive or effective a wiper ring may become, it is still subject to, and restricted by, whatever drain provisions are offered in the piston groove. If these groove drains are inadequate or become easily clogged, any wiper ring is immediately nullified in direct proportion. Drain holes in the piston are of necessity restricted in size by the size of the groove itself. Mutiple notched wiper rings are also difficult to clean and in this cleaning opera-

*Assistant to the president, C. Lee Cook Manufacturing Company.

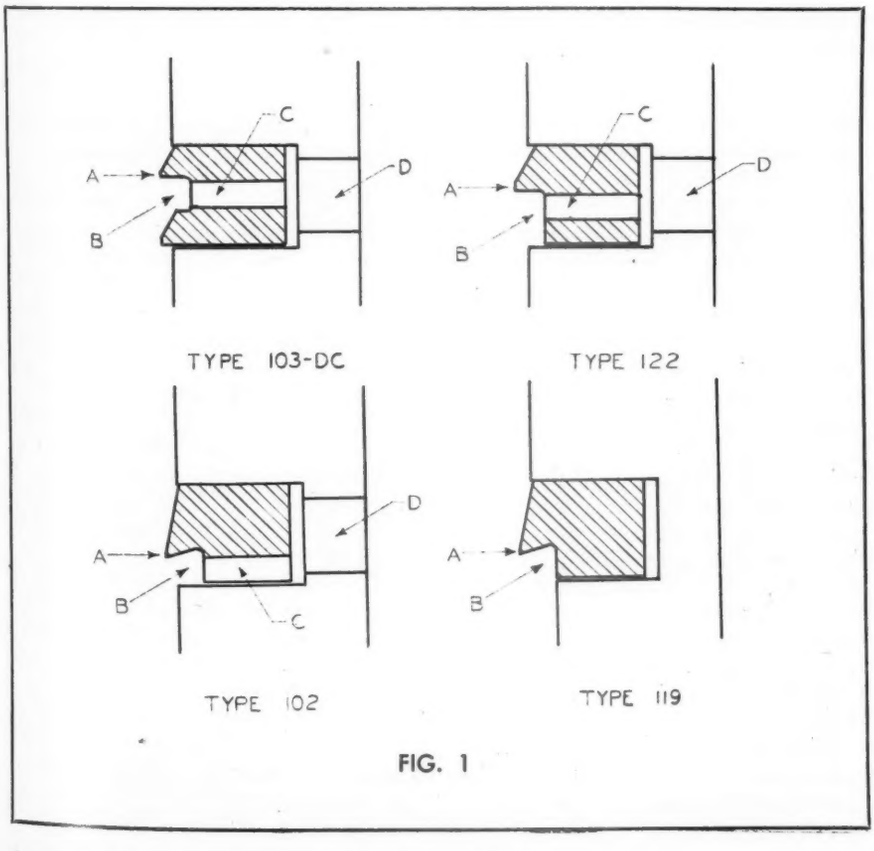


FIG. 1

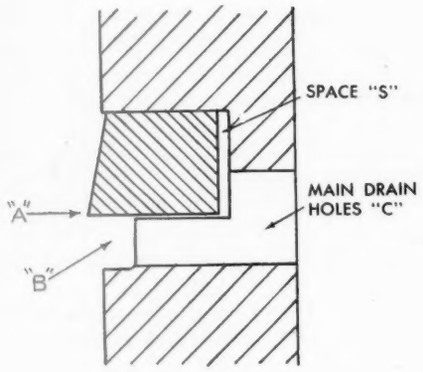
tion they may be distorted or their wiping edges damaged and even destroyed.

Hydraulic pressure, due to inertia or flow restrictions, will build up in the collecting channel (b) during the downstroke. This force acts in direct opposition to the ring tension. It is possible with ring types 122, 102, and especially type 119, where it might become great enough to break scraping edge contact with the liner wall.

Whenever it becomes advisable to use expanders behind wiper rings to increase their working effectiveness, the expanders themselves represent a further restriction to the oil from reaching the piston drain holes.

In many cases, due to necessary piston design, the wiper ring grooves may have to be unusually shallow. This makes it impossible for the manufacturer to provide a ring of sufficient radial thickness to obtain enough tension. Expanders, in a case of this kind, become a "must" and, to make room for the expander, a further weakening of the ring results. The ring's normal life is shortened. It is more difficult to manufacture and distortion is almost inevitable during fabrication and handling.

Let us now consider a suggested arrangement as shown in Fig. 2. Here,



TYPE 118

FIG. 2

the collecting channel (b) has been provided permanently in the piston land below the ring. As already mentioned, this can be machined in a single operation with tools arranged to cut both the ring groove and the oil channel at the same time. No cost would, therefore, be added to piston manufacture.

Oil return holes (c) are provided so that they drain both the oil collecting channel and the back of the piston grove. It will be noted that with this plan, the holes are no longer restricted in size by the ring groove width. They can be made much larger, of any desired size, to suit the operating conditions or oil drain requirements. As they may be larger, they can be provided more economically from the standpoint of manufacture. Both the oil collecting channels and the drain holes can be quickly and easily cleaned without any fear of distortion or injury to the piston.

As two of its former components have now been eliminated, the ring's manufacture becomes greatly simplified and the added cost over a plain snap ring would be very negligible. The ring retains essentially its full cross-sectional area and all the factors of weakening or distortion are no longer present. Maximum tension is possible and such a ring is easily cleaned.

Hydraulic pressure, which might build up in the piston oil collecting channel (b), has no effect on the ring tension and tends only to force the oil through the return holes. Because the space behind this ring is no longer important as a distribution space to piston drains, a full radial thickness can be provided in the ring. This is important from the standpoint of good tension and would be especially advantageous when shallow grooves are a necessity of piston design.

If expanders become advisable, they may be used without unduly affecting or restricting the piston drain holes.

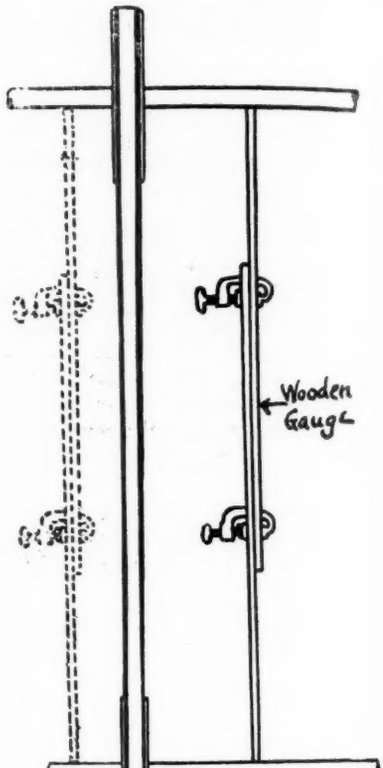
On the scraping or downward stroke, the piston moves much faster than the natural gravity flow of the returning oil, and inertia resistance will cause hydraulic pressure to build up in any area where the oil is confined. Consequently, oil trapped in space "S" Fig. 2 behind the ring will tend to force the ring outward toward the cylinder or liner wall.

The axial width of the oil collecting channel on the piston should be approximately one-half the axial width of the ring groove. The radial depth of the channel should be approximately one-quarter of the groove depth and the size and number of drain holes may be determined to suit the operating conditions and the amount of oil to be handled. It is well to note here that too many is most often better than too few. Oil removed from the liner must have ample opportunity for quick return to the crankcase.

With this method of piston treatment, even a plain snap piston ring might be satisfactory for a great number of applications. * * *

How to Make a Shaft Aligning Gage

THE accompanying sketch shows an excellent and inexpensive "home made" gage for aligning shafting—or nearly anything else for that matter particularly where it is desired to make things parallel. The gage consists of two pieces of light, slender, stiff, wooden pieces, and two clamps of ordinary make. With a gage like this, clamped to the correct length, it is a very simple matter to move it to another position, as shown dotted, and thus check up two shafts to determine whether or not they are parallel. For example if in Position A the ends of the gage "just touch" and if in Position B they also "just touch," the shafts are parallel. The gage will touch only at the points of minimum distance. If the shafts are not parallel the distance between them will not be the same along the entire length. If the shafts are parallel, the gage will "just touch" at both ends at every place of measurement.



It is obvious that a wooden gage of this kind is far superior to a cord because it does not stretch or shorten. It is handled with greater ease and certainty than a cord. In nearly any plant of any size it is worth while to keep a gage of this kind on hand for use as a permanent tool for all kinds of checking where accuracy is desired.—W. F. S.

Pipe Line Compressor Lubrication and Maintenance*

Tennessee Gas Transmission has a definite schedule for analyzing oil samples, making recommendations, keeping operating records

O. H. MOORE†

THE maintenance of lubricating oils in the gas engine compressor is receiving more attention from the operator, the lubricating engineer, and the manufacturer of reconditioning equipment than ever before. As a result, many of the lubricating problems are being solved by the exchange of operating data from plant to plant and between gas companies. The oil companies are sending lubricating engineers into the field on routine schedule to assist in a more efficient performance of their lubricating oils. These engineers have an opportunity of seeing their oils in use under varying conditions and can often go directly to the trouble, thereby assisting the operator immensely.

At this point I would like to describe briefly the Tennessee Gas Transmission Company's compressor equipment for the benefit of those who might not be familiar with it.

There were seven initial stations consisting of fifty-eight 1000-hp angle type units. Two of these stations were in Texas, one in Louisiana, one in Mississippi, one in Tennessee, and two in Kentucky. Additional stations have since been added to where we now have four in Texas, two in Louisiana, two in Mississippi, three in Tennessee, and four in Kentucky, with the fifth one being constructed in Kentucky this year. The total installed compressor horsepower will equal 322,120 by the end of this year.

There are 241 angle type compressors of 1000 hp to 1600 hp, thirty-two 1600-hp horizontal type compressors, and three 2000-hp centrifugal compressors. In addition to the main compressor units, each station, with the exception of the centrifugal plant, is equipped with auxiliary engines of sufficient generating power to supply all lights, power for circulating pumps, cooling tower fans, etc., to make each station independent of all outside power.

The Tennessee Gas Transmission Company has been in operation only since 1944, consequently our lubricating experience has been with equipment of the latest design, both with respect to compressor units and oil conditioning equipment. I believe we have the distinction of being the first major transmission company to start initial operation with the angle type compressor. Fig. 1 shows the growth of the company as to installed horsepower with comparative availability curve.

Fig. 2 compares the gas sales to the theoretical pipe line capacity.

With this equipment extending from Corpus Christi, Texas to West Virginia, a different operating problem is presented than if it were all within one plant or under one roof. To contact each station personally means traveling at least 2500 miles, requiring a minimum of two weeks' time. We have been able to get all station superintendents together at one time only once in the five years of operation. This was the first time the men were even able to meet each other. Changes in personnel have been made since that meeting and we are faced again with the superintendent of one plant not even knowing the fellow at another plant.

Due to these plants being so widely separated, we are forced to rely heavily on the written word. Each company supplying oil to us sends a lubricating engineer into its respective plants on routine schedule to pick up oil samples and to discuss analysis of previous samples with the operators. These samples are sent in to the laboratory for analysis, and copies of the results are sent to the station and to the Houston office. A general set of recommendations is prepared for all samples reported on, with these recommendations being sent to the Houston office.

We originally equipped each main engine room with two 2H1 Hilco reclaimers, placing these filters in the basement in the end of each building. All engine crankcases were manifolded to pipe headers, which permitted the filtering of the oil in each engine on the bypass principle by simply switching from engine to engine. Three-way valves were used in the oil header at each engine with the operating levers linked together to insure the return of the oil back to the engine from which it was being taken. Fig. 3 is a flow sheet of the installation of the oil conditioning equipment.

Fig. 4 shows a plan view of installation for one reclaimer unit.

Similar header arrangement was used on the auxiliary engines, with the C1 Hilco reclaimer unit being used in this installation.

Fig. 5 is a cross-sectional view of the Hilco oil reclaimer. The dirty oil pump pulls direct from the crankcase of the engine, sends the oil through the heat exchanger, on through an electric heater unit, and into the top of the filter, where it comes in contact with a Fullers' Earth bed. Oil then passes through the bed into the vaporizer section, on through the heat exchanger to the clean oil pump, and is then sent back to the engine crankcase. A vacuum pump maintains vacuum in the vaporizer section to pull

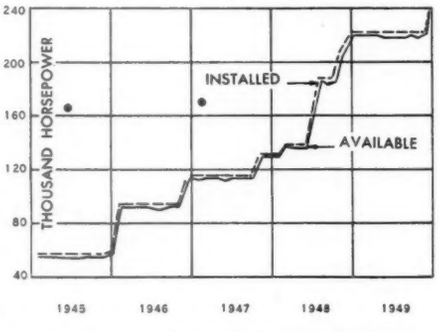


FIG. 1. Available and installed horsepower. (Available horsepower corrected for mechanical down time.)

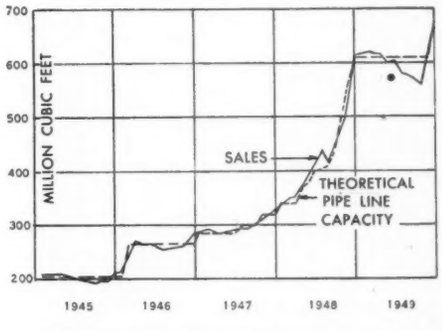


FIG. 2. Average daily gas sales at 15.025 lb pressure base.

*Presented before The American Society of Mechanical Engineers, New Orleans, Louisiana.

†Compressor superintendent, Tennessee Gas Transmission Company.

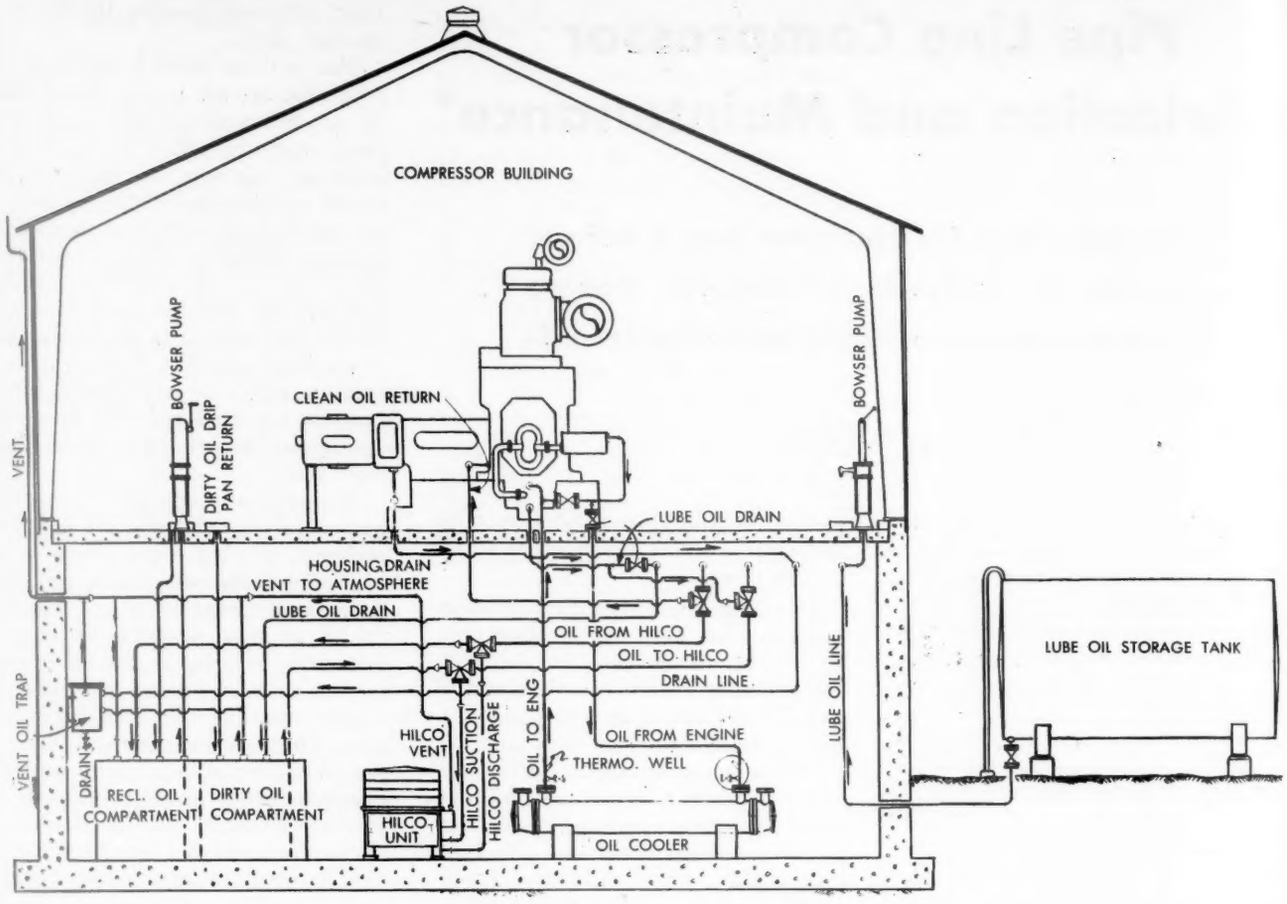


FIG. 3. Compressor building lube oil system detail flow sheet.

off any light ends that might be in the oil.

We have followed the practice of trying to maintain the crankcase oils in as new condition as possible. Many of our plants are still using the initial charge of oil. Additional oil, of course, has had to be added to the crankcases, but there hasn't been a general changing of oil. This period of operation is, of course, short in comparison to other gas companies and other batches of oil, as our operation covers a period of five years to date.

Turbine oils were probably the first to be reconditioned and used over and over. I do not have any records that I can quote on the length of service, but I did have the good fortune of attending a lubricating school some two years ago in Nashville, Tennessee, and one operator present stated that he knew for certain that the circulating oil in his turbines had been in service for 40 years. I do not believe that this record can be equaled by the engine operator, principally because a number of years passed before the engine operator learned that his oil did not wear out, but instead became contaminated with foreign substances.

I previously stated that the initial equipment on the Tennessee Gas system was the angle type gas compressor. Two makes of angle type units were first installed, with the third make being added in 1946. As a result, we can now make comparative study of the service from these three makes of angle type compressors. In addition to this equipment, we have three plants equipped with the horizontal twin tandem double-acting type compressor, and still a different type engine used in the auxiliary building.

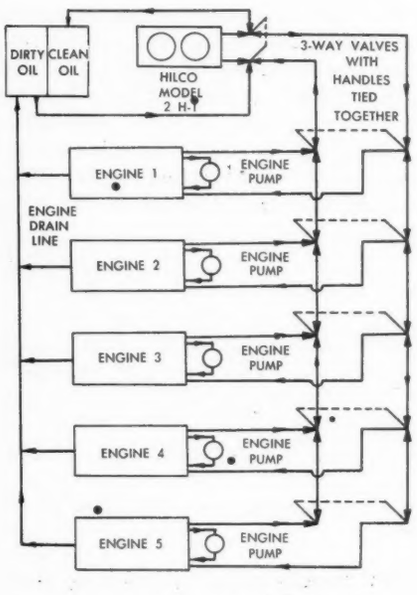


FIG. 4. Lube oil flow diagram, Station 2.

We soon discovered after a period of operation that the crankcase oil in some of these engines was harder to maintain than in other engines. To assist the reclaimer, we have since installed filters on individual engines where necessary.

Fig. 6 is representative of the type filters installed on the individual engines.

As our plants grew in size, requiring the second engine room, we moved one of the 2H1 units from the original building over into the new building, connecting all engines in each engine room by two common headers and arranged the single 2H1 unit in series with a Honan-Crane 2036 filter. With this arrangement and the filter on each individual engine, we have been able to maintain the crankcase oils in as many as 11 engines on the single 2H1 and Honan-Crane filters in satisfactory condition.

Table I gives a comparative record of six different companies' oils and shows how well the oil conditioning equipment is performing its duty.

Fig. 7 shows suggested changes to improve the oil purifying system that

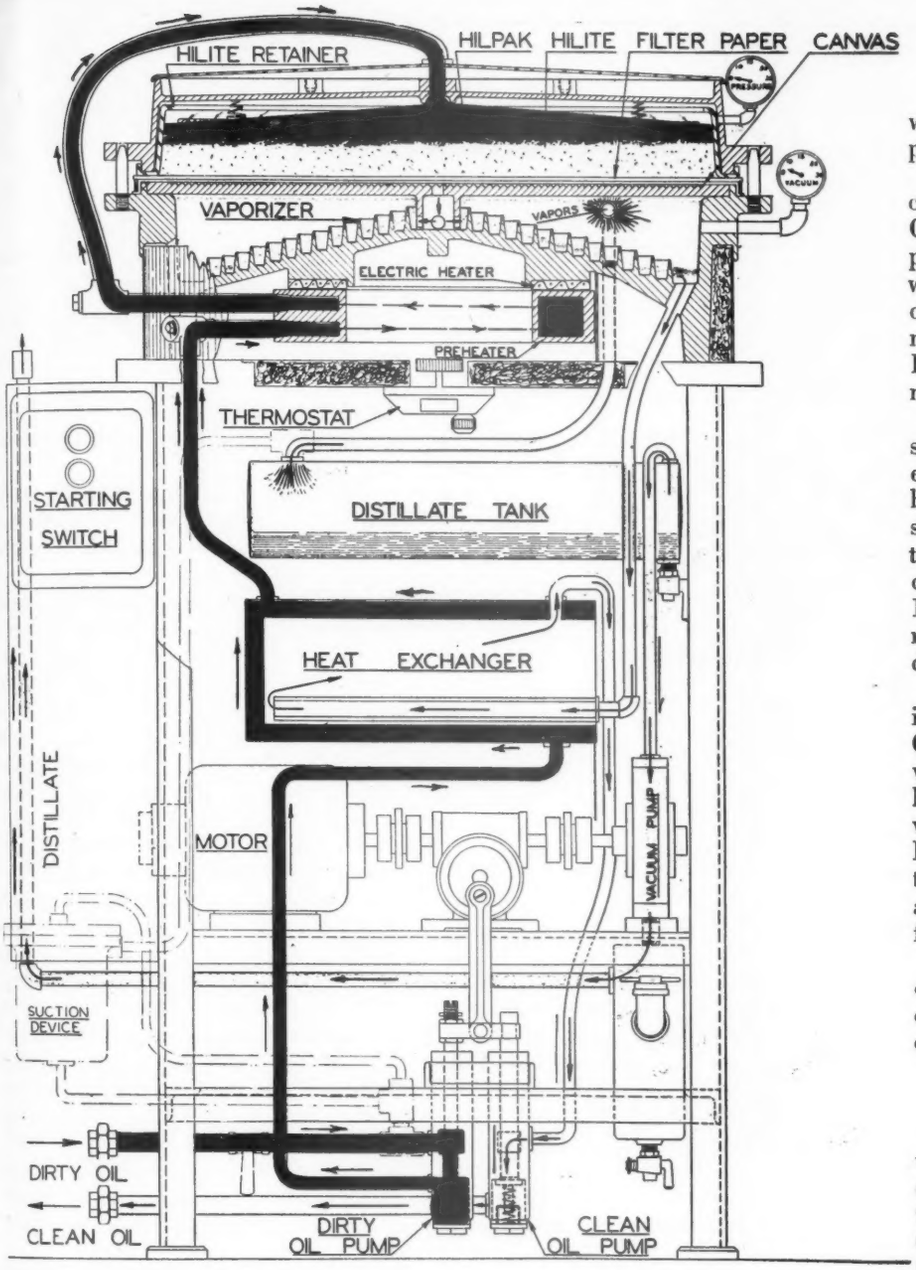
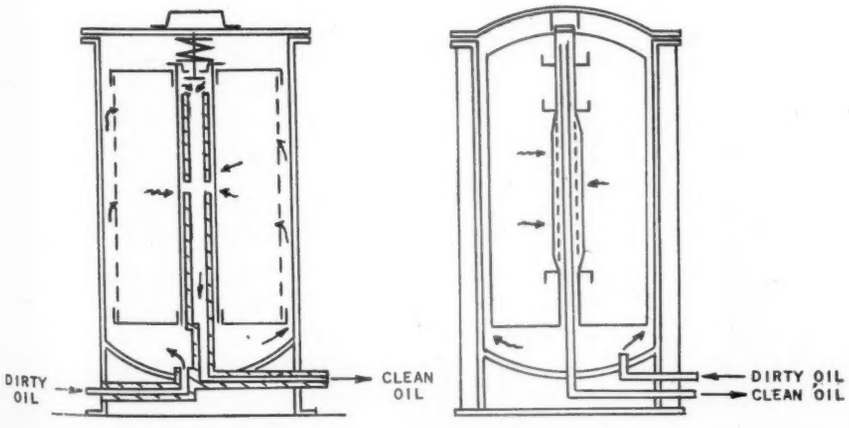


FIG. 5. Average monthly crankcase oil consumption.

FIG. 6



Hyflow filter. Crane filter.

were sent out to the stations the latter part of April.

The arrangement of the Hilco reclaimers in series with the Honan-Crane filter was selected for the purpose of seeing whether improvement was possible when using the Hilco reclaimer to remove the sludge and moisture from the oil stream, and the Honan-Crane Earth bed to control neutralization.

The alternate pipe arrangement was suggested as the existing ¾-in. headers extending the full length of the building, having three-way valves situated at each engine, were offering too much resistance to the flow of the oil. The second set of pipe headers of 1¼-in. size were installed with connections as shown to reduce friction drop.

The scheme of using two filter bags in the Honan-Crane unit, placing Cranite in the inner bag and cotton waste or cellulose material in the outer bag, was suggested in the installations where the Hilco reclaimers and Honan-Crane units are in parallel for the purpose of catching the sludge and gunk in the cellulose material before it reached the Cranite Earth.

These suggestions shown on Fig. 7 originated as a result of a test made on a C1 Hilco reclaimer at our No. 2 compressor station.

Time Hours

Fig. 8 shows two curves with the volume of oil passing through the reclaimer per hour plotted against the total hours of service of the filter bed. Curve No. 1 shows that a rapid reduction in the rate of flow through the reclaimer unit was taking place as a result of clogging of the filter bed. Curve No. 2 shows the hourly rate being maintained rather uniformly after individual Hyflow filters were placed on each engine.

Before these individual filters were installed on the engines, the C1 reclaimers had to be repacked once every 24 hours. After the installation of the individual filters on the engines, the reclaimer was repacked only three times between April 1 and April 14. The Hyflow filters on the individual engines were still operating on their initial filter pack on April 14, in spite of the fact that they had to clean up the crankcase oils in the engines. Receiving these capacity curves from the station showing such vast change in the performance of the filtering equipment made us realize that we possibly had many installations where the ac-

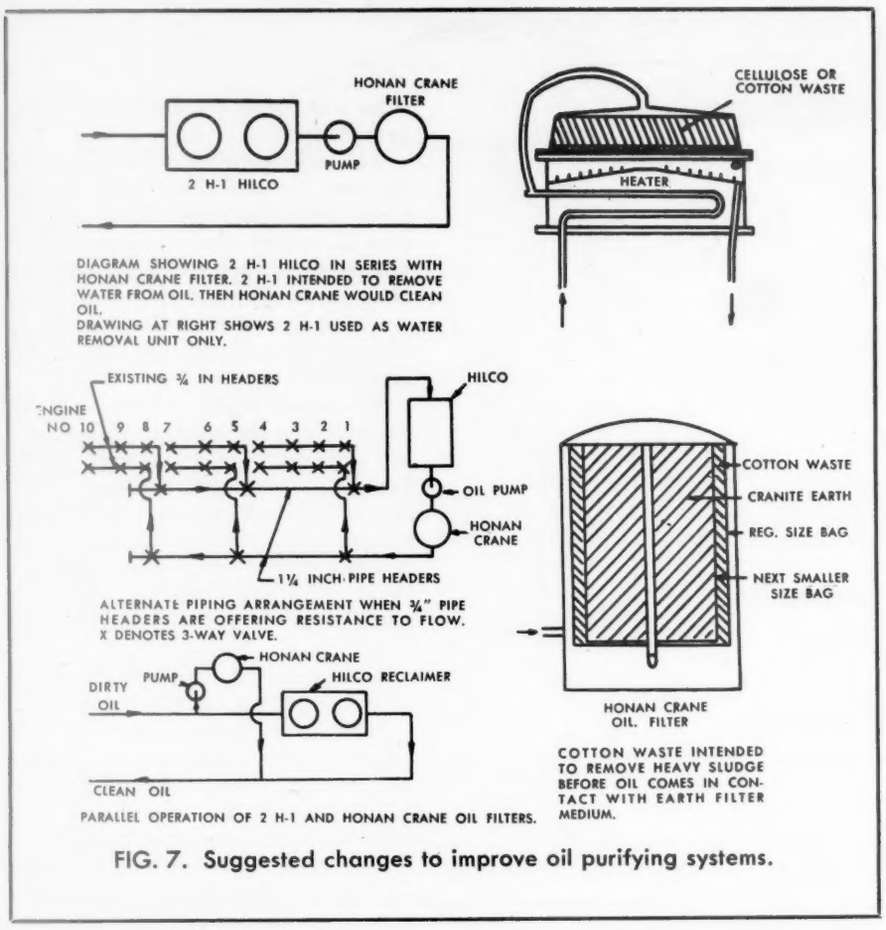

HONAN CRANE FILTER
PUMP
2 H-1 HILCO
DIAGRAM SHOWING 2 H-1 HILCO IN SERIES WITH HONAN CRANE FILTER. 2 H-1 INTENDED TO REMOVE WATER FROM OIL. THEN HONAN CRANE WOULD CLEAN OIL.
DRAWING AT RIGHT SHOWS 2 H-1 USED AS WATER REMOVAL UNIT ONLY.
CELLULOSE OR COTTON WASTE
HEATER
EXISTING ¾ IN HEADERS
HILCO
ENGINE NO 10 9 8 7 6 5 4 3 2 1
OIL PUMP
HONAN CRANE
1¼ INCH PIPE HEADERS
ALTERNATE PIPING ARRANGEMENT WHEN ¾" PIPE HEADERS ARE OFFERING RESISTANCE TO FLOW.
X DENOTES 3-WAY VALVE.
HONAN CRANE
HILCO RECLAIMER
DIRTY OIL
PUMP
CLEAN OIL
PARALLEL OPERATION OF 2 H-1 AND HONAN CRANE OIL FILTERS.
COTTON WASTE
CRANITE EARTH
REG. SIZE BAG
NEXT SMALLER SIZE BAG
HONAN CRANE OIL FILTER
COTTON WASTE INTENDED TO REMOVE HEAVY SLUDGE BEFORE OIL COMES IN CONTACT WITH EARTH FILTER MEDIUM.

FIG. 7. Suggested changes to improve oil purifying systems.

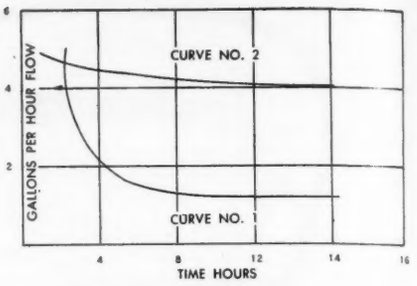


FIG. 8. Flow chart C-1 reclaimer.

FIG. 9. Oil test kit.

tual volume of oil passing through the equipment was well below the rated capacity of the unit, thereby preventing as good a filtering job. These suggestions were sent out with the hope of making further improvements in the oil conditioning equipment.

The oil analysis shown in Table I for stations No. 2, No. 4, and No. 6 is on oils from three different companies, but are from the same make engine, which incidentally is the easiest engine we have on crankcase oils. This make engine has a single scavenger cylinder completely separated from the crankcase by means of a crosshead housing and distance piece. This type unit also has a very long power piston. One 2H1 Hilco reclaimer is adequate to take care of as many as six of these units without filters on individual engines.

The analysis under station No. 8 in Table I represents another make engine and another oil company. I might say that this is the hardest engine on crankcase oil. In this engine the main crossheads act as scavenging pistons to supply the required scavenger air. Very short power pistons are used in this type engine.

The analysis of the oil at station No. 9 in Table I is from the third make engine. In this unit two double-acting scavenger cylinders are provided on intermediate crank throws closely connected to the crankcase.

I do not consider myself an engine designer, and I hope that none of you gentlemen ask me why these engines perform differently. I am presenting this information only to develop a certain angle of thinking, and would like to have anyone comment that would like to. Is the scavenging air escaping into the crankcase causing the oxidation of the lubricating oil, thereby making it more difficult to maintain the crankcase oils in one engine, as compared to that of another?

Table 1.

Station	Date	Gravity	Viscosity at 100 F	Viscosity at 210 F	Neut. No.	Carbon	Color	Service hours
2	8/2/49	27.3	831		.10			30,952
	10/27/48	27.5	806		.14			19,749
	2/12/48	27.6	834		.04			14,570
	7/21/47	28.0	791		.08			11,145
	12/10/46	28.4	623		.03			9,257
	New oil	28.0	804		.01			
4	4/4/50			77.1	.03	.32		
	8/26/49	28.8		77.0	.03	.29		
	8/18/48			77.0	.06	.37	3.50	
	9/10/47	29.3		75.8	.02	.32	4.00	
	8/16/46	29.6		64.8	.05	.16	9.00	
	8/24/45	29.1		65.5	.06	.16	4.00	
	New oil	29.4		76.1	.03	.26	4.50	
6	6/7/49	28.8	678		.04	.18	5.00	
	12/7/48	28.7	719		.01	.23	6.00	
	1/6/48	28.3	726		.06	.39	6.00	
	2/15/47	28.3	485		.11	.10	5.00	
	3/26/46	29.3	517		.08	.08	4.50	
	New oil	27.3	610	67.3	.02	.10	3.00	
8	11/30/49	30.2	568	68.2	.06			
	1/12/49	29.1	591	69.3	.03			
	11/5/47	28.6	640	70.6	.45	.38		
	9/14/46	29.6	573	67.8	.13	.17		
	2/23/46	27.7	562	67.8	.14	.25		
	10/10/45	29.8	544	66.5	.15	.18		
	New oil	27.3	600	68.0	.02	.05	5.00	
9	11/1/48			70.0	.16		5.50	
	11/1/47			71.5	.22	.31	4.25	
	5/1/47			71.3	.28		7.50	
	1/1/47			70.2	.20		6.50	
	9/13/46			68.6	.28		7.00	
	New oil	27.3	610	67.3	.02	.10	3.00	

Pipeline on the March

... And a fast-stepping "march" it is with "Caterpillar" equipment in command. Just the kind of equipment that's needed to speed projects directly or indirectly associated with the national defense! To supply both rearmament and civilian activities with natural gas, the final section of the big "Super Inch" is here seen approaching its terminus near Llanada, California. With military unison, three "Cat" D8 Tractors put long stretches of welded pipe to bed – fast but gently. Of course they're outfitted with the right gear for such work. Offset track, plus added counterweighting, puts mighty lifting-and-lowering capacity into their Trackson Pipe Layers.

Because the work is tough, varied – and ceaseless around the clock – "Caterpillar" equipment has figured in the construction of most of the estimated 17,000 miles of pipeline laid in '51. It is widely preferred because (1) "Cat" machines can handle so many pipeline jobs – in clearing right of way, ditching, stabbing, welding, wrapping, doping, lowering, backfilling, cleaning up; (2) because they STAND UP under all kinds of punishment; and (3) because there is always within reach a "Caterpillar" dealer rich in experience and facilities for keeping them on the job. So, while governmental emergency demands come first –

Take your maintenance problems to your "Caterpillar" dealer* BEFORE *parts are worn beyond repair

He can build up track grousers, rerim sprockets, turn track pins and rollers for new wearing surfaces, refinish cylinder liners and crankshafts, recondition pistons, cylinder heads, radiators – salvage many other parts that will keep your machines operating dependably and lengthen their life.

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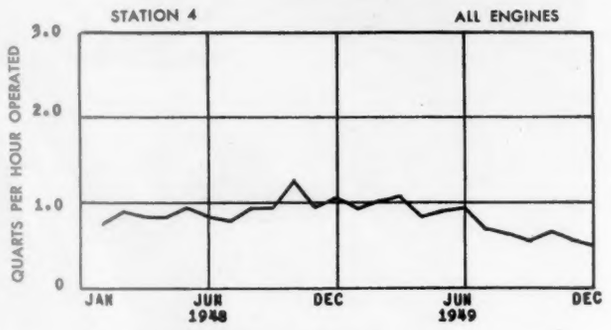
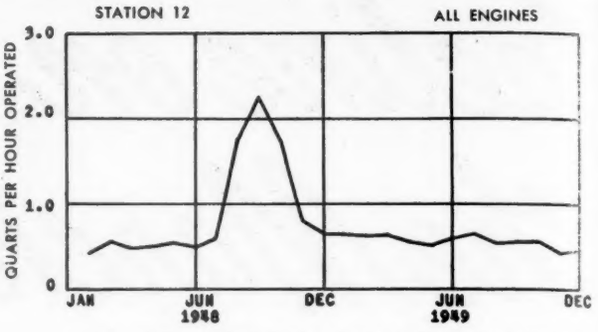
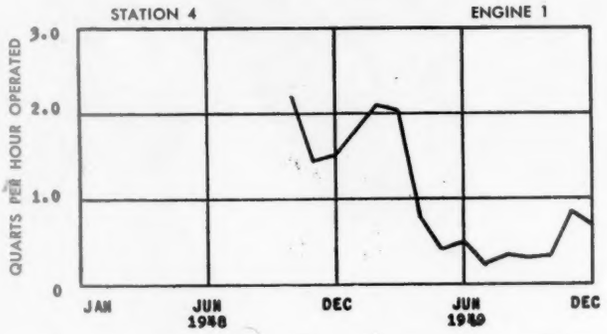


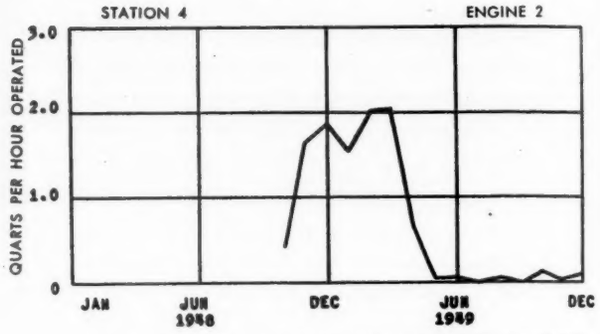
OCT., 1948— TWO NEW ENGINES INSTALLED
JAN., 1949— OIL WIPER RINGS INSTALLED IN CENTER RING GROOVES, ENGINES 1 AND 2
APRIL, 1949— NEW OIL WIPER RINGS INSTALLED IN CENTER GROOVES, ENGINES 1 AND 2



AUG., 1948— WRONG TYPE OF OIL WIPER RINGS INSTALLED IN 8 ENGINES
OCT., 1948— NEW OIL RINGS INSTALLED IN 8 ENGINES
NOV., 1948— NEW OIL RINGS AND EXPANDERS INSTALLED IN ALL ENGINES

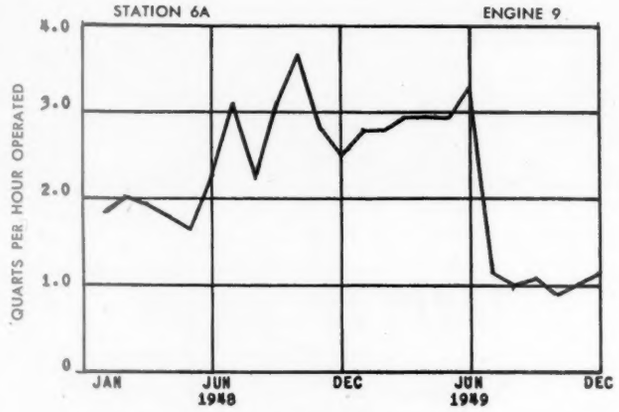


APRIL, 1949— NEW OIL WIPER RINGS INSTALLED IN CENTER RING GROOVES

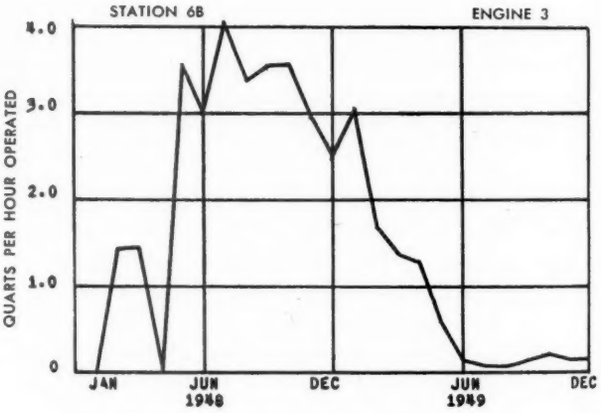


APRIL, 1949— NEW OIL WIPER RINGS INSTALLED IN CENTER GROOVES

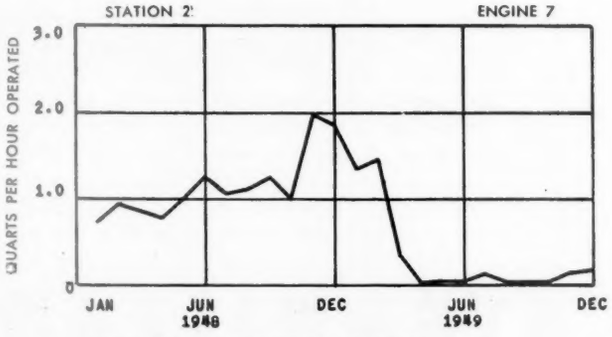
FIG. 10. Average monthly crankcase oil consumption.



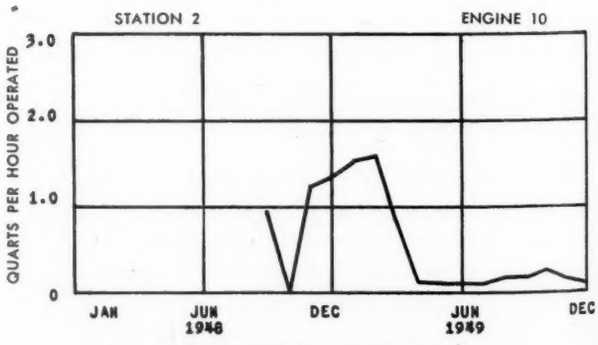
NOV., 1948— NEW OIL RINGS AND EXPANDERS
MAY, 1949— NEW RINGS AND 2 NEW PISTONS
JULY, 1949— NEW RINGS, 4 NEW PISTONS. AND 2 NEW PINS



NOV., 1948— WRIST PIN CAPS REPAIRED
FEB., 1949— CENTER RINGS REMOVED
MAY, 1949— OIL WIPER RINGS PUT IN CENTER GROOVES



MARCH, 1949— NEW PEDRICK OIL RINGS



MARCH, 1949— NEW PEDRICK OIL RINGS

FIG. 11. Average monthly crankcase oil consumption.

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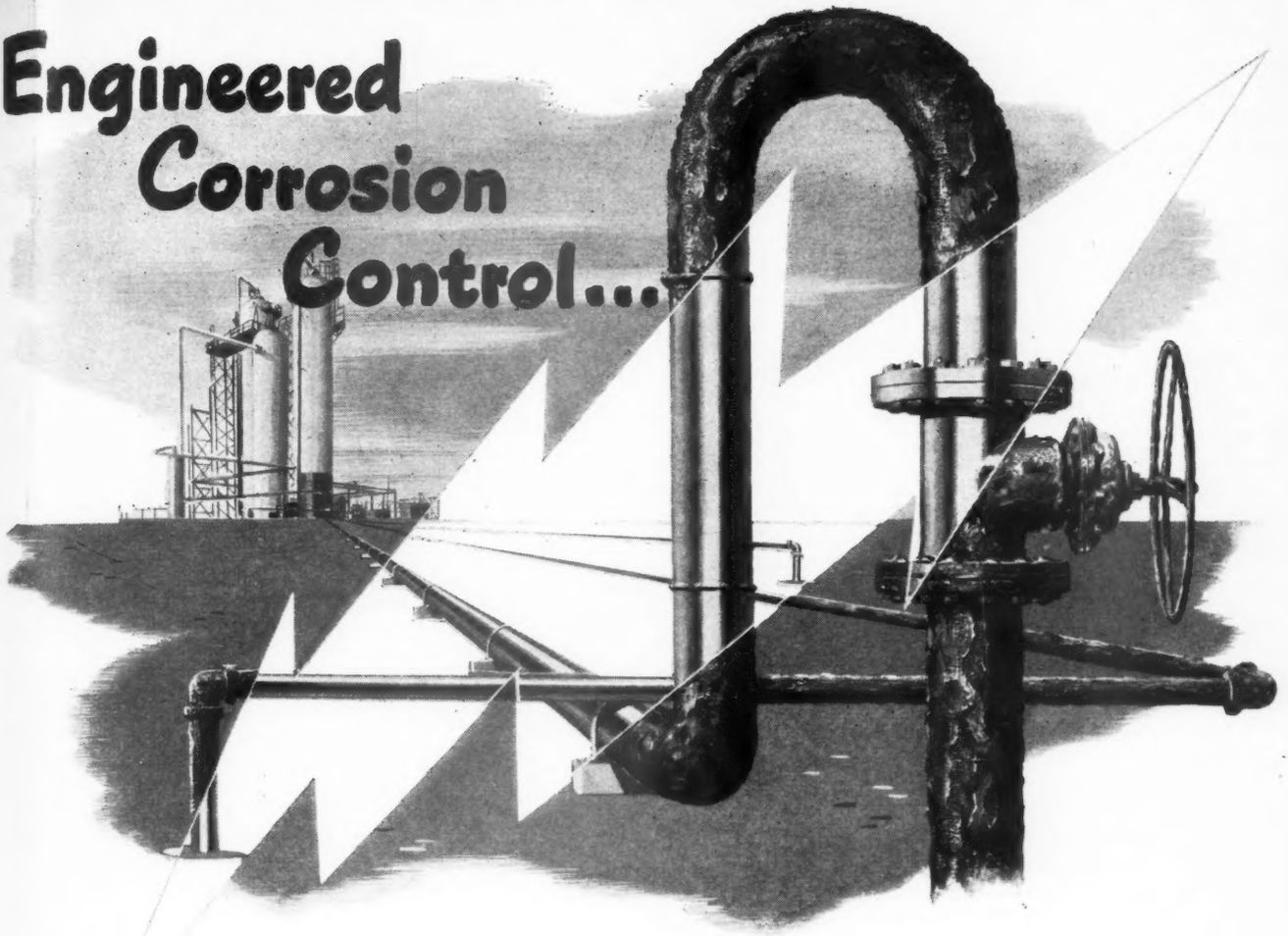

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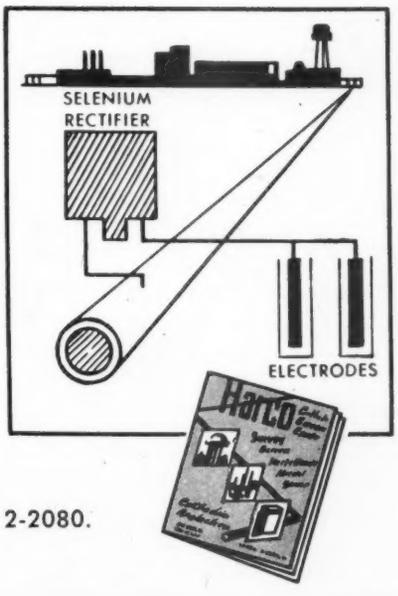

THE *Harco* CORPORATION *Cathodic Protection Division*

OFFICES IN PRINCIPAL CITIES

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We know for a fact that air causes oxidation of lubricating oil. There is no possible way for scavenger air to get back into the engine crankcase in the first engine; nor is there any way for the lubricating oil of the scavenger cylinder to get back into the crankcase of the engine. In the second engine, scavenger air can very easily get by scavenger piston rings into the crankcase. Also, this scavenger cylinder is lubricated directly from the crankcase with a special valve returning the oil that gets by the scavenger piston back to the crankcase. In the third make engine, the scavenger air can escape around the piston rod into the crankcase.

So much for the oil conditioning equipment. I would now like to turn to the service that we are receiving from these various compressor units. Much has been said, as well as published, on brake horsepower hours per gallon for lubricating oils. Figures have been quoted up into the 10,000 to 15,000 hp-hr per gal, but I believe in most instances careful examination will show that these figures come from the record on one engine or from only the oil used on power cylinders or crankcase, and do not represent the overall oil economy for the station. Our business is pumping gas, and we, charged with the responsibility of the compressor department, attempt to operate the equipment in such a manner as not to be criticized by management for not delivering the gas. We have worked rather diligently on the amount of lubricating oil consumed, but we have not attempted to make a figure at the expense of maintenance. For sake of information, I might quote our overall system average horsepower hours per gallon of oil consumed:

1945	2692 hp-hr
1946	2270 hp-hr
1947	2612 hp-hr
1948	2778 hp-hr
1949	3305 hp-hr

As a matter of record, I made spot checks on several plants and found that the average cylinder wear was from 0.00015 in. to 0.0005 in. per thousand hours of operation on angle type engines. These micrometer readings were taken from 216 cylinders. I might state further that the minimum wear in the angle type engines was found in the units that were the hardest on the crankcase oil. These short piston type engines are equipped with four ¼-in. width compression rings, as compared with 7/16-width rings on the other engines. The wear record on the horizontal type engine is not quoted, as we lost the first set of power rings through no fault of the equipment. Changes were made in the installations and we are still operating on the replacement rings with no measurable wear.

Some piston rings have been removed, but we have many installations with 40,000 to 50,000 hr of service. Compressor piston rings are giving good service, but not as good as the power rings. Indications are that we are getting from 15,000 to 30,000 hr out of the compressor rings. However, we have original rings still in service with 30,000 hr of operation, so we don't know how long they will run. The life of these rings is, of course, dependent upon how efficient our gas scrubber equipment is, as well as how much foreign matter moves through the pipe line to the station.

In addition to the oil samples that are picked up by the oil company's representative, we are experimenting with a Gerin oil test kit (Fig. 9). This kit is a very compact unit that provides a quick and simple means of determining the condition of an oil. Satisfactory tests can be made on viscosity, asphalt, water, solids, metal, and acidity.

This portable kit design is especially desirable for the traveling engineer, but can be set up in a station to be used as a check against the laboratory analysis. The plant operator can make simple daily checks on the lubricating oils without spending an appreciable amount of time on this test work. It is of great benefit in determining when filter packs should be changed. As previously mentioned, carbon and sludge frequently plug the voids in the outer layers of the filter packs, preventing oil from flowing through the filter beds. Simple sedimentation tests can be run to determine the extent of foreign matter moving with the oil stream. With the aid of this kit it is possible to keep the filter unit up to capacity instead of waiting until pressures build up, indicating decrease in flow of oil.

There are many problems in the operation and maintenance of compressor stations in a system extending from the Rio Grande Valley in Texas to West Virginia. The operating personnel is of utmost importance. This applies particularly to the supervising personnel and the operators in charge of each shift. These men have to be quick, accurate thinkers and calm in every emergency. The superintendent frequently finds himself the chief advisor to his employees. These plants are so situated that they become a community, functioning as a unit, and the superintendent must be the leader.

Operating records, unless accurate, are of no value. In fact, they are worse than no records at all. We have, by no means, been able to keep records up to 100 per cent efficiency, but we are keeping a good set of records and have attempted to keep them as simple as possible. Operating curves on lubricating consumption are shown in Figs. 10 and 11 on the rate of crankcase oil consumed, plotted in quarts of oil used per engine hour of operation. This is a simple, easily constructed curve and is very catching to the eye. These curves are maintained on each engine, with the crankcase, power piston, and compressor cylinder oils all plotted on one sheet. The plant average figures are plotted on the different make engines and then accumulated into an overall system average curve for all make engines in the system.

A monthly summary sheet is prepared by each plant, showing all the pertinent operating data compiled from the daily operating forms. These summary sheets are sent to the Houston office where they are made up into a monthly report, with copies of the system figures being furnished each plant. Then at the end of the year a composite report is made up on the entire year's operation.

I trust that you will not think that I am bragging by quoting a statement from our annual report to stockholders. "Continuous maintenance was performed on the pipe line system during the year. By such constant maintenance emphasis on safety measures and application of proved operating techniques, the company has been able to operate its pipe line continuously during the past five years without interruption of service because of failure of equipment." I feel that we can be justly proud of this record, especially in view of the tremendous construction program carried on in conjunction with the regular operating problems.

* * *

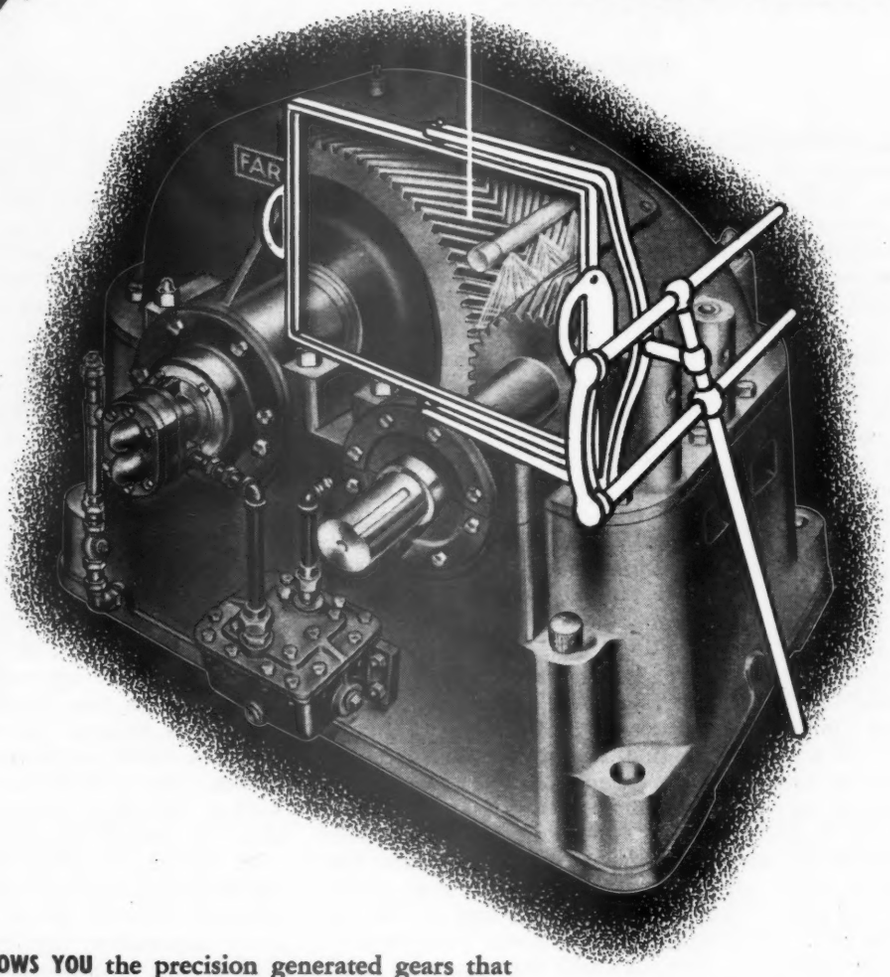
Socony Adds Tankers

Socony-Vacuum Oil Company, Inc., has ordered two new tankers, which, when completed, will be larger than any others in the company's fleet. Socony-Vacuum currently operates 55 deep-sea tankers in worldwide shipping through ownership or long-term charter.

One of the tankers will be built by the Sun Shipbuilding Company at Chester, Pennsylvania, with delivery scheduled for December, 1952. The other will be built at Quincy, Massachusetts, by the Bethlehem Shipbuilding Company with delivery scheduled for about the same time.

This X-ray View Shows You—

WHY NO FARREL® SPEED INCREASER HAS EVER FAILED IN PIPELINE PUMPING SERVICE



IT SHOWS YOU the precision generated gears that operate quietly and efficiently through long years of service . . . the completely self-contained circulating oil system that virtually puts power on velvet . . . the extra large precision-ground shafts . . . the oversize, accurately finished bearings . . . and the exceptionally rigid housing.

IT DOES NOT SHOW YOU the knowledge which has been accumulated by Farrel engineers in the making of thousands of gear units for oil field, industrial and marine service . . . the data obtained from customer service reports . . . or the extensive tests conducted by the company's research department—all of which have contributed to the reputation these units have for providing long, *trouble-free performance with minimum maintenance.*

BUT WHY NOT TAKE A MORE THOROUGH LOOK . . . first, at our bulletin 448-A, which describes these speed increasers in detail . . . and, then, at some units in actual operation. We shall be glad to send you a copy of the bulletin, without cost or obligation . . . and, also, tell you where there are some Farrel speed increasers installed in your locality.

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Only a detailed study can determine whether cathodic protection will pay in a specific case, but here are some guiding facts that will be helpful to such a survey

The Rational Approach to Cathodic Protection

MARSHALL E. PARKER

WHENEVER the subject of cathodic protection comes up, management quite naturally wants to know "Will it pay?". That it will pay in general is now well established — hundreds of sets of leak records bear witness to it —but still the question is asked "Will it pay *in this case?*".

The only way to answer the question convincingly, of course, is to examine that case in detail—to make a corrosion survey of that particular pipe line—and then, on the basis of the survey, and of the known performance of various types of cathodic protection systems, make an economic study of the whole problem. Such a survey and analysis naturally costs money—and management is frequently reluctant to authorize the necessary expenditure, particularly when the line in question is not forcing itself upon their attention by having a large number of expensive leaks. All too often the leak rate of a system increases gradually, a maintenance force is built up gradually to cope with it, and what is an extremely expensive situation is accepted as normal, merely because it did not at any specific time suddenly become acute.

There are a number of pipe line companies in this country—including some of the "big boys"—which could show a handsome profit indeed by having an experienced corrosion engineer look over their system and their methods, then sit down and tell them what to do about it; *provided* they would then and there set about doing it.

Although it is quite true, as already mentioned, that a specific program for a specific line can only be drawn up on the basis of a detailed study of the line, it is also true that some answers can be given with a high degree of probability to the question of cathodic protection on certain broad categories of problems. To the all-important question "Will cathodic protection pay *in this case*" qualified answers of "yes," "no," and "maybe" are given here for several cases.

Case 1 — A Line Now Having Leaks. The answer here is "yes." The method, the approach, must depend upon several other factors besides the mere fact that the line is leaking. How old is the line? How long has it been having leaks? How rapidly are they occurring? How are they distributed along the line—generally, or in a few "hot spots?" The answers to all these questions will have a real bearing on the decisions to be made.

If the line in question is an old one, and has been experiencing leaks for a considerable time, the case for cathodic protection does not look good at first glance. In all probability the leak rate has become fairly stabilized, and there exists a routine procedure for making repairs. Such a state of affairs can come to be accepted as normal, and there is no consciousness of the need for a change in routine. A line like this does not *demand* attention, as does one whose snowballing leak rate causes constant requests for additional personnel, equipment, and appropriations. Yet there exists here an excellent opportunity for sizable savings by the judicious use of cathodic protection.

This may take the form of a complete system, designed to afford protection throughout the length of the line; or of a series of smaller installations, to afford partial protection in the worst places—the "hot spots"; or of a program of complete or partial reconditioning of the line, with the application of cathodic protection; or, in the worst cases, of virtually complete replacement, again with cathodic protection. In actual practice, "hot spot" protection or reconditioning plus complete protection are more likely to be chosen than either complete protection "as is" or complete replacement. Experience has shown that carefully planned "hot spot" protection will reduce leak rates by 80 to 90 per cent, at a total cost of perhaps 20 per cent of that required for complete protection. These data refer to bare lines; coating, even when relatively poor, usually indicates full protection.

Reconditioning, partial or total, must always be the subject of a careful study. If the circumstances justify this course, they will almost certainly justify the application of cathodic protection—as a supplement to good coating—on the reconditioned line. For the conditions that brought about the need for reconditioning will certainly cause damage again. Furthermore, if the reconditioning includes (as it nearly always will) the insertion of an occasional length of new pipe where the old is beyond repair, the galvanic action between old and new steel will certainly result in an attack even more aggressive than was originally the case. It must also be taken into account that the application of cathodic protection will make possible the use of thinner pipe walls, with a consequent saving far greater than the cost of the protection.

If the line is relatively new, and has begun to develop leaks, the argument for cathodic protection is even more impressive—for leak rates invariably increase, and conditions will get out of hand rapidly unless protection is afforded. Under these circumstances, the line is probably in excellent condition except for the few places where the exposure is most severe, and the prompt application of a properly designed system of cathodic protection will pay for itself in the increased salvage value of the pipe, even if the savings in leak costs are totally disregarded.

If the line is an old one, and has just begun to have leaks, then cathodic protection applied with too much enthusiasm and too little judgment can easily cost more than it saves, for such a line will in all probability serve for a long time with very few additional leaks, and no more can be afforded for protection than will be saved by the forestalling of this small number of leaks. If some portions of

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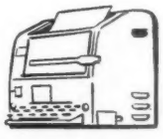

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the line happen to lie in locations where a single leak might prove to be very expensive—in crowded built-up areas, under buildings, or in hazardous locations—then a local system to insure protection in those areas may be justified as a form of insurance. Otherwise, the old line with a sparse leak record can most economically be protected by small installations in the areas where trouble develops.

Case 2—A Line That Has Not Leaked. If an old line has never leaked, there is every reason to say that cathodic protection is not indicated. The only reason for not giving an unqualified "No" is that some condition may subject the line to an exposure that was not there originally. This may take the form of a cathodic protection installation on an adjacent or crossing line; however, in this case there is no indication for cathodic protection *as such* on the line in question, but merely the recommendation that it be taken into consideration, that it be "looked at" from the viewpoint of cathodic protection. This will normally be the function of those responsible for the installation on the other line, whether it be of the same or of foreign ownership—and corrosion engineers in general have been most conscientious in this matter.

If it is a new line, of course, the fact that it has had no leaks tells nothing; certainly the matter should be investigated. Often experience with lines in the same general vicinity may be quite valuable in making decisions, but there is a trap for the unwary along this road. If the new line parallels an old one, and records show that the old line had no leaks, or only a few, then it would seem to be the most reasonable assumption that the new line is no more in need of protection than the old. *This is a most dangerous assumption*—one that has cost many thousands of dollars. The danger is particularly great if the new line is looped with the old — with cross-connections at intervals. The reason for this apparent anomaly lies in the basic galvanic theory of corrosion.

When a structure of iron or steel is buried in the soil, it will normally exhibit an initial potential of 0.7 to 0.9 volts negative with respect to a standard copper sulfate electrode. With the passage of time this value decreases, rapidly at first, then more and more slowly. The initial and later rate of voltage decay is somewhat variable, depending upon the composition of the soil, the amount of moisture present, and numerous other factors, but the basic shape of the curve is the same for virtually all conditions encountered. After several years, a steel pipe may have a potential as low as 0.4 or 0.5—some have even been measured as low as 0.2. Whatever the rate of decline, a newly installed piece of steel will always have a potential negative with respect to an older one in the small soil. If the two are connected together — as through cross-overs — the potential difference between them will create a galvanic cell that will actively corrode the new pipe. The same effect occurs when a new section of line is installed in an existing line; and since this is usually done in an area where the old line was destroyed by corrosion, the effect is enhanced, with the result that the new pipe does not last as long as the old one did! This peculiarity of behavior, as exhibited in the case of replaced sections, and in the case of looped lines, has led to a widespread opinion among field men that the steel being made nowadays is not as good as it used to be!

Case 3—A Planned Line. The new line discussed above was assumed to be one already in existence, hence there was no discussion as to how it should have been installed, the type or quantity of coating, etc.; it was assumed that the problem of corrosion was being considered after the construction of the line.

The time to consider the problem of corrosion on a pipe line, however, is prior to construction, while the project is in the planning stage. This is not often done, unfortunately. There are so many urgent and pressing problems confronting those charged with the responsibility of planning that little attention is given to phases of the project that do not demand attention. Corrosion is never a pressing problem at this stage. Consequently, there is a strong tendency to defer decisions, to adopt "standard" practices, to get the line in the ground and then hand it over to the operating department to worry about.

One possible answer to this regrettable tendency to overlook corrosion as a problem in pipe line design is to assign responsibility for that one phase of the design to a corrosion engineer — preferably to one who does not have the responsibility for any other phase of the particular project involved. As far as this individual is concerned, then, there will be no problem connected with the line more pressing than that of corrosion.

But what of the promised answer to the question "Will cathodic protection pay—for a new line?" The answer is "yes — if it is properly coordinated with the design." There are few areas where the soil is so uniformly non-corrosive that a line may be laid bare therein with no resultant damage from corrosion. Even when the corrosivity is so low that no serious interference with operation results from it, there will usually be a loss in ultimate salvage value of the pipe greater than the cost of a program of complete protection. For a planned line, the most economic solution is coating plus cathodic protection. The major question is the selection of the coating. The cheapest coating available will mean excessive current requirements, and hence excessive protection costs; the very best coating obtainable sometimes will cost more than it will save. There is, for any particular line in any particular route, a balance point. The determination of this point naturally requires a careful investigation of the conditions along the line, the probable useful life of the line (which may be an indefinite term), the current and probable future power costs, the properties and costs of the available coating materials, and numerous other factors. The important fact here is that such a balance point exists, and can, for a specific case, be determined; and the final solution will almost invariably be one that does involve cathodic protection.

This type of protective system must be accepted as having many of the characteristics of insurance. The cost of cathodic protection of a well-coated line is so low, as compared with the losses that corrosion will entail, that it is a justifiable investment in areas not known to be corrosive, or even in those believed to be non-corrosive. It is impossible to prepare a conclusive and specific balance sheet to justify the cathodic protection of a planned line, for the simple reason that it is impossible to make an accurate prediction of the leak rate on such a line. The many studies of comparative leak records on older lines, before and after cathodic protection, together with the low cost of properly engineered (from the planning stage) cathodic protection of new lines, establish its value as a form of insurance whose "premium" to "probable loss" ratio is extremely low.

Case 4 — Other Structures. In

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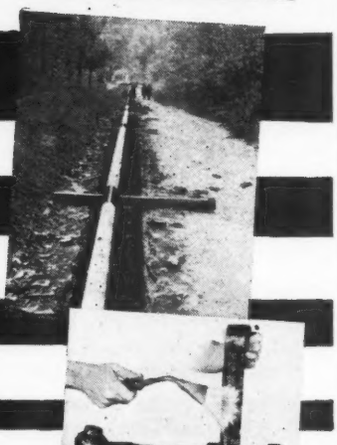

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addition to pipe lines there are, in the petroleum industry and others, countless other structures of metal exposed to the corrosive activity of soil and water. Cathodic protection has been applied successfully to many of these — storage tank bottoms, buried storage tanks, water tank interiors, steel piling, bridge piers, offshore drilling platforms, well casings, steel barges and other vessels, wharves and docks, transmission tower footings, and many, many others. There is no doubt that a very large number of other structures exist to which cathodic protection is applicable, but which have not yet been so treated.

From the engineering point of view, structures such as these must be divided into two categories: Large and small. The approach must be fundamentally different, for the following reason. A large structure may readily be made the object of a specific engineering study, and a system designed for its protection embodying the best that is known on the subject. On the other hand, small structures cannot be so handled. The typical small butane tank is a good example; there may be hundreds of them, all exactly alike, but when they are installed, there will inevitably be a tremendous dispersion in the characteristics of the soils in which they lie. No general prescription can be written for the cathodic protection of a set of units like these, and their small unit value cannot justify an essentially expensive investigation of each. A similar, but not so severe, problem confronts those concerned with the cathodic protection of domestic hot water heaters. This problem has been at least partially solved by tailoring the installation to fit the typical domestic water supply in various cities and areas; the agreement is not perfect, but it is statistically sound, and very good results have been achieved.

Summary

To the question *"Will cathodic protection pay in this case?"* the following answers, all qualified, have been given:

In the case of a pipe line now having leaks—"Yes."

In the case of a line that has not leaked — "If the line is an old one, probably no; if it is new, yes."

In the case of a planned line—"Yes —almost every time."

In the case of other structures exposed to similar conditions—"Maybe —in a great many cases, yes."

Probably the major unsolved engineering problem connected with cathodic protection is that of affording adequate, low cost protection to small units. * * *

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P 615.91

RIVER CROSSING CONSTRUCTION*

Description and comparison of the materials, designs, and methods of installation employed in laying large diameter lines under major rivers.

F. HILL SANDERS, JR.†

THE following quotation describes a technique used in 1893 for crossing the Hudson and East Rivers:

"Where the New York Pipe Line Company's 6-in. trunk line from Olean, New York, into Hunter's Point, Long Island, passes under the Hudson and East Rivers, it is double—that is, the 6-in. pipe is placed inside of a larger one in tight-fitting sleeve joints. The jacket pipe has its ends separated by a space of 12 in. to permit the enclosed pipe to be screwed home. The sleeve is then pushed over the 12-in. gap, and the whole space between the pipes is filled with lead poured in melted. The line is held in place on the bottom of the river by 2 sets of heavy chains parallel with the pipe and about 25 ft from it, one on each side. Every 300 ft, a guide chain connects the pipe with these lateral chains; and beyond each one of these connections an anchor, weighing over a ton, keeps the whole in place. The line crossing the salt marches approaching the river is laid in a rectangular wooden box, filled with hydraulic cement to withstand corrosion."

From this quotation it is seen readily that the main problems which confronted the pipeliners 57 years ago are the same today; i.e., that the utmost must be done to insure that a river crossing is installed properly, and that, upon completion, it is protected against corrosion. The engineers who made this crossing did not have available the large dredges, tractors, and other equipment of today, but were forced to use the materials and equipment at hand. Nevertheless, they succeeded in their project. But American engineering ingenuity has progressed with construction needs to the extent that we can now install large-diameter pipe across the major rivers of the world almost as a routine procedure. The rivers of today are the same as they were in 1893, but the pipe lines have increased considerably in size and pressure; and it is with this thought in mind that this paper is presented.

To cover all phases of under-water pipe lines would consume much more than the allotted time, but the most pertinent problems common to all are included herein. The conclusions drawn are not based on personal opinion but, rather, on those of the majority of constructors and engineers who were interviewed; and no claim is made to an all-conclusive bible. One personal opinion is that a major river crossing is of utmost importance to the system of which it is a part, and should be given every consideration in planning and installation. The value of a river crossing is not measured in dollars required for installation, maintenance, or replacement, but it is measured more with respect to the economic value of this section to the entire line. Some sections are so important that, without them, many miles of land lines would be useless. A pipe line that transports 150,000 bbl per day on a 30-cent tariff has a gross income of $1,350,000 per month; and to have this cease because of failure of a crossing would be drastic. It would involve not only the loss in revenue and expense to the carrier, but the shippers in turn would be confronted with the problems of other means of transportation for their oil. To borrow a portion of the old British poem, "The Laws of the Navy" . . . .

> "Upon the strength of each link in the cable dependeth the might of the chain."

When it is necessary to cross a major river with a large-diameter pipe, the problems that are to be studied might be enumerated as follows: Selection of the site for the crossing, selection of the pipe to be installed, design of the crossing, selection of coating and weighting materials, installation methods, and inspection and test to insure good workmanship.

Crossing Site

Usually the general area in which a river crossing can be made is determined by the proposed route of the line and, often, existing facilities and the necessity of including certain points along the line dictate the positive location. When an area of choice does exist, however, the factors entering into the selection of the best place should be considered, and the line so routed should take advantage of the most desirable site within such area of choice. To begin with, all available information with respect to the river must be at hand. High and low-water stages, maximum width and depths to be expected, current velocity, angle of slope of banks, accessibility—and last but by no means least—bottom stability. The U. S. Army Engineers have been studying river characteristics for many years, and their advice and information are invaluable. Some of the factors listed are for construction convenience and economy. Others are vital to the success of the operation itself. Fortunate indeed would be the engineer who could find a site with all the desirable features within a reasonable distance of the proposed alignment. Not being overly blessed with miracles, the pipeliner must usually settle for a site with certain vital features, and hope for the best in the rest. For example, it is a "must" that the banks and bottom be stable enough to withstand the effects of scouring‡ and erosion that might uncover and leave suspended any part of the line after installation. If dredging operations are to be attempted, the depth of the water at all stages during the anticipated construction time must be considered, because dredges are limited to the depth in which they can perform. A selection of the construction period when the river is at its extreme low-water level is very important because the high-water stages, in addition to causing greater depth, could widen the river to great extent and increase the current velocity. It is important that the crossing be made at a straight section of the river rather than in a curve, because the water action on the banks

*Presented before American Petroleum Institute, Los Angeles, California, under the full title "Developments in Large-Diameter River Crossing Construction."

†Sun Pipe Line Company, Beaumont, Texas.

‡Washout of the stream bed.

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causes changes. A uniform bottom is desirable because the presence of any degree of variation would necessitate a deeper trench—with a resulting increase in the volume of the earth to be moved. To fail in trenching to the deepest point would be to invite disaster from a suspended section of pipe. Sand bars are to be avoided, if feasible, because of their tendency to shift; and, if they must be crossed, the line should be placed to a depth that will afford stability. This all adds up to construction problems and cost. From an observation of the crossing sites selected by various companies, as well as the working period, it is apparent that final security for the line and favorable water stages were the overriding factors in location, even though installation costs were in some cases considerably higher than would have obtained at a less desirable site.

Selection of Pipe

The selection of pipe for a river crossing requires much more thought than that for land lines, as it is a relatively simple matter to repair overland lines; whereas in the vast majority of cases a river line cannot be repaired, but must be replaced. We have observed that some companies have saved substantial amounts of money on land lines by using a pipe made from steel with a higher carbon content than is considered ideal for construction and welding purposes. In such cases, the harder steel allows for thinner wall thicknesses without decrease in the tensile strength. With the thousand-mile lines of today, it is easy to see that a very slight reduction in wall thickness can represent a tremendous dollar saving in steel and shipping costs. On the other hand, high carbon steel contributes to welding difficulties and has a greater tendency, especially at low temperatures, to snap. There is calculated risk in this, of course, with initial savings balanced against possible excesive "breakage." Most river crossings are relatively short, and any saving in weight per foot from this practice would be negligible as compared to risk from breaks—and the consensus on selection of river pipe is that brittleness is to be avoided at all cost. In river lines we only take those risks—calculated or not—which are forced upon us. Generally speaking, most large-diameter crude oil lines on land have walls varying between ¼ in. and ⅜ in., with carbon and manganese in the 0.28 to 1.00 per cent range, respectively—with some slightly higher. Studies of various river crossings indicate that seamless pipe with a wall thickness from ½ in. to 1 in., with a tensile yield test of 50,000 psi and with a lower carbon content—usually in the 0.20 to 0.30 per cent range, with an 0.30 per cent maximum — is favored. The variation in wall thickness from ½ in. to 1 in. results from the difference of opinion on how best to add weight for negative buoyancy; it has nothing to do with operating pressures.

TABLE 1. Summary of chemical and physical properties of steel used by various companies for land pipe.

Size, in.	Wall thickness, in.	Carbon per cent	Manganese, per cent	Tensile yield test, psi
24	0.300	0.22 to 0.30	0.55 to 0.90	52,000
26	0.250	0.20 to 0.30	0.90 to 1.25	52,000
26	0.281	0.20 to 0.30	0.90 to 1.25	52,000
26	0.312	0.30 average	1.00 average	52,000
26	0.312	0.32 to 0.38	1.20 average	52,000
14	0.250	0.30 average	1.25 average	45,000
26	0.303	0.30 to 0.38	1.20 to 1.40	52,000
22	0.281	0.22 to 0.32	1.00 to 1.10	50,000
20	0.250	0.33 average	1.28 average	42,000

TABLE 2. Summary of chemical and physical properties of steel used by various companies for river pipe.

Size, in,	Wall thickness, in,	Carbon per cent	Manganese, per cent	Tensile yield test, psi
20	0.500	0.20 to 0.30*	0.55 to 0.90	50,000
26	1⅛	0.21 to 0.29*	0.65 to 1.00	52,000
20	0.500	0.20 to 0.30*	0.60 to 1.00	45,000

* Maximum.

Design of Crossing

Next comes the design of the stream installation, which will govern construction methods. It must be decided whether a single or dual crossing will be made. Will the line or lines be put in straight across the stream; will they bow upstream, downstream, or both? Often the decision as to single or dual lines is determined by operating necessities, construction costs, and the considered value of an "insurance" line. As previously pointed out, the continuous operation of the line is all-important. If a stream or body of water has a stable bottom, and if it is static or almost so, a straight crossing, because of obvious savings in pipe and construction, is most generally used. In rivers such as the Mississippi, Missouri, and others with a flowing current of from 4 to 10 miles per hour there is considerable difference of opinion as to direction and value of camber in relation to the current. These questions arise: Which is best—an upstream catenary or a downstream catenary; and what is the ideal curvature in such lines? These questions of design are considered only when the river bed is earth or silt. If it is solid rock, there is no question that a line straight across should be used.

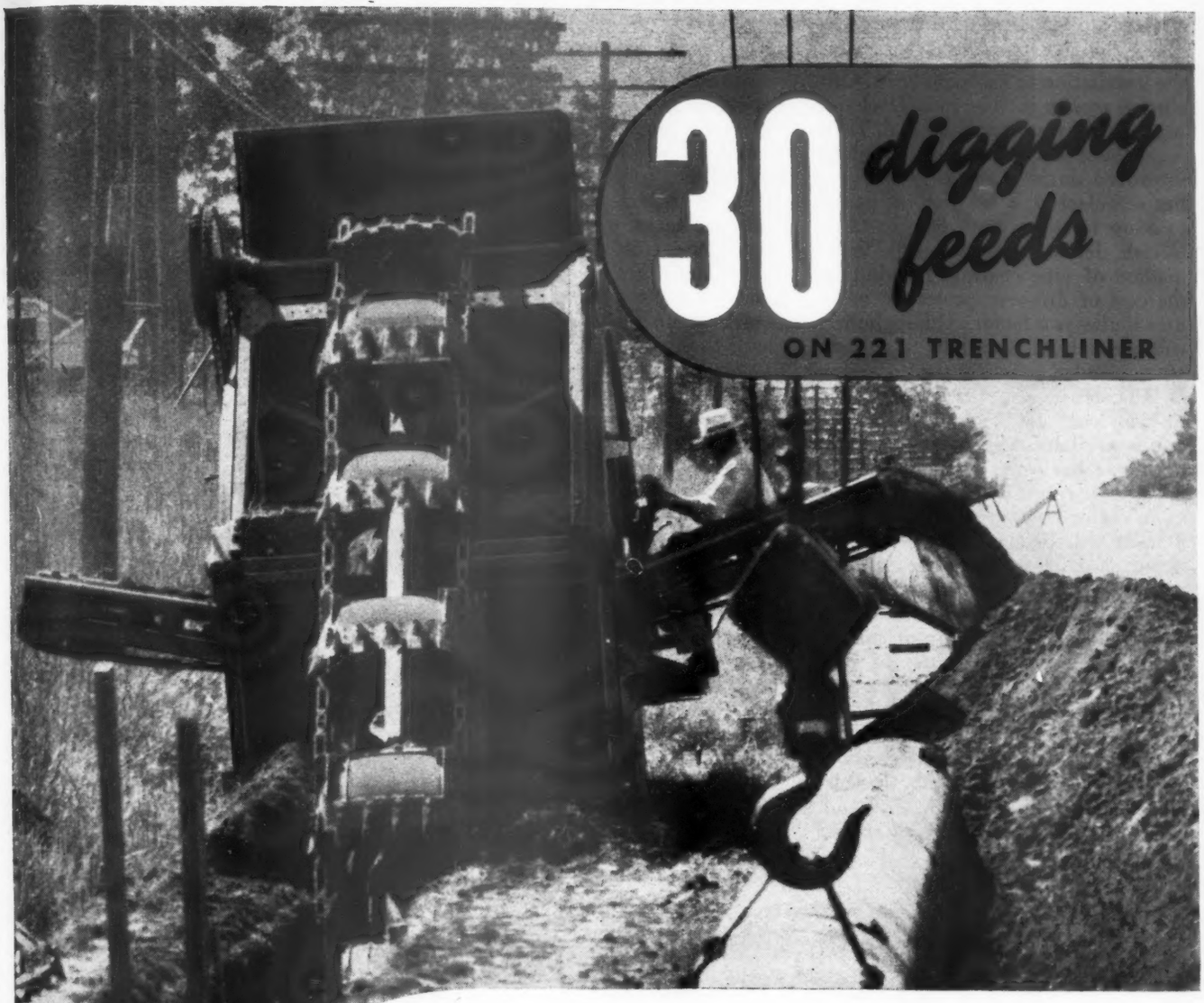
Proponents of the upstream bow say in its favor that pipe in compression is less subject to outside force and will not exert any "pull" on the land lines. Rather, they contend that any action against the pipe will merely communicate itself to the land line, which should be adequately covered and anchored by the trench and backfill—thus minimizing the possibility of a break under water. Engineers also believe that, if the current ever does scour beneath the pipe and causes it to "swing," the weight of the line and the slack from its upstream curve will force it to follow the bottom down.

Engineers who favor the downstream catenary do so on the theory that pipe in tension, if it ever is suspended in the stream bed, will better resist "rippling" action by the river current than pipe in compression. Furthermore, they point out that the pipe is already in more tension than most currents would develop, and that the water would rush down rather than up— thus helping to "reseat" the line. It is true that a short section of an upstream bow, caused by concentrated action, could go into tension, thus forming an undesirable S-curve.

Certainly there is something in favor of each design, and in one recent major crossing of the Mississippi dual 20-in. lines were installed, with one bowing each way. The degree of curvature for either type of bend seems to be determined by the amount of natural "sag" the pipe will develop without mechanical bending, and by the distance desired between lines. The distance that separates the line should be sufficient to prevent the same scouring action that affects both lines. It should be pointed out here that lines that have been constructed with the use of each discussed design have been lost to the river; also each type has been successfully installed and maintained. To indicate the line of thought on design: Six crossings of major rivers were studied; two bowed upstream, two downstream, one both ways, and the other was straight across.

Pipe Coating and Weighting

Although practically all companies are agreed that coating for corrosive protection is necessary, they differ somewhat on the type of covering and its thickness. For river lines, it appears that many companies favor a somastic-type coating from ¼ in. to ⅝ in. thick. Others use a coal-tar enamel applied in varying thicknesses, and still others prefer a glass-fiber and asphalt coating. In practically every case, the river lines are isolated from the cathodically protected land lines by insulating flanges. In many cases no cathodic protection is provided for river lines, as their comparatively



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Rigid, arch-type main frame keeps digging boom precision-aligned . . . maintains low center of gravity for safe work and travel over uneven terrain. 3-point suspension mounting lets crawler frames oscillate up to 8 inches for equal weight distribution on rough ground. Bearing pressure is low . . . only 7 lbs. per square inch on long, wide, self-cleaning, tractor-type crawlers.

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P133

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PARSONS *Trenchliners*®

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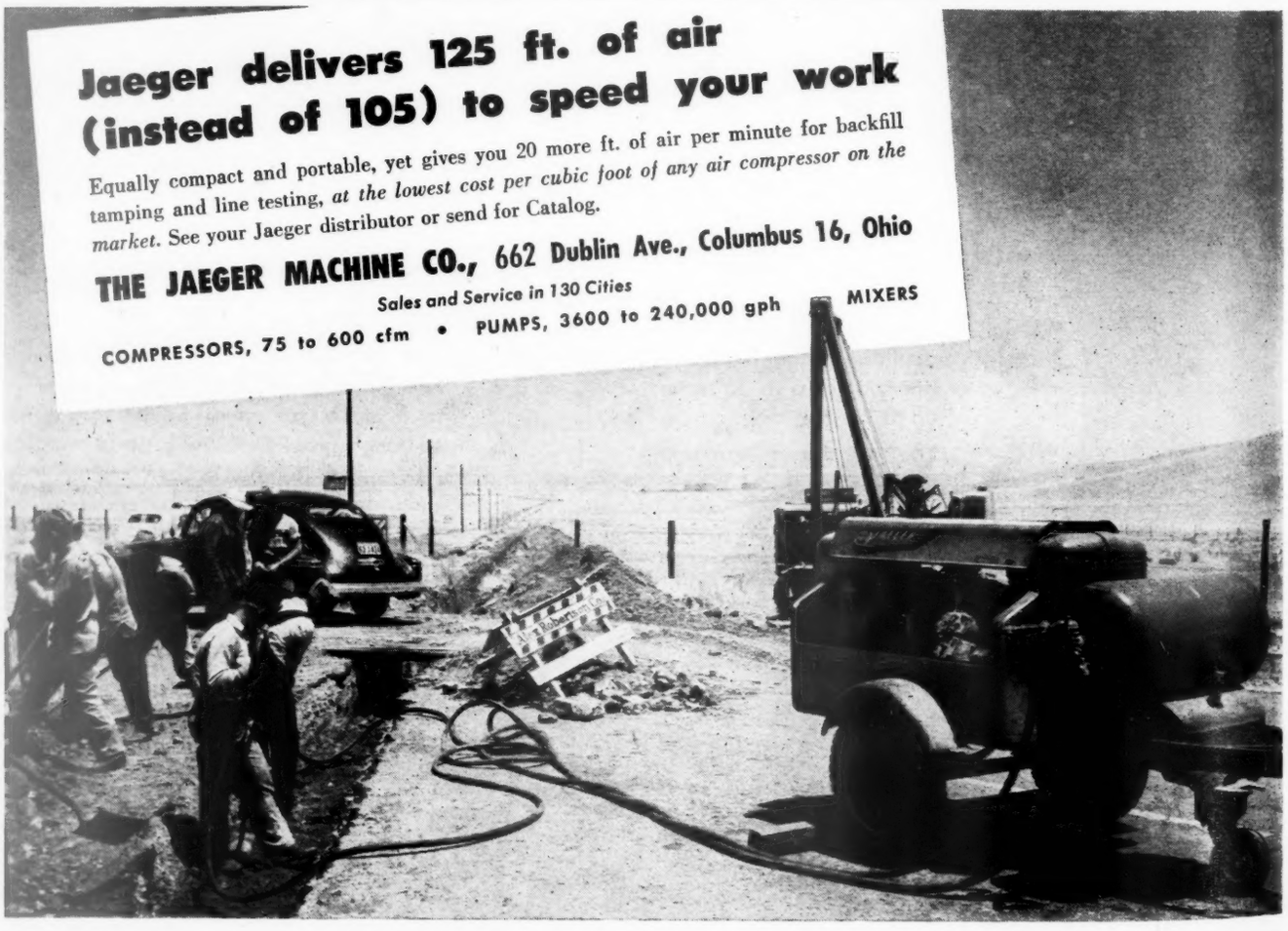
short span does not allow appreciable current "buildup," thereby justifying the installation of cathodic units. Conclusive results in this rapidly changing field are necessarily limited. There is no doubt that coating practices have improved during the last few years, but sufficient time has not yet passed to allow tests extensive enough to establish definitely any overall "best" method of pipe coating. In addition, the cost of different protective measures is always a factor. Although there will certainly be dissenters to any one recommended practice, the consensus in the corrosion field is that a somastic-type coat is the most favorable means available today to the pipe-line industry; but some feel that its cost is prohibitive except in special cases, as in major river crossings. Even so, it must still be decided whether the importance of the crossing and the possible expense of replacement because of corrosive elements justify the cost of somastic. Many prominent engineers feel that crossings of such rivers as the Mississippi, because of tremendous construction expense, call for the use of the absolute best in material that makes up the line, without consideration of cost. With the current interest and research in corrosion protection, the next few years should provide some highly interesting results to the industry.

In conjunction with protective covering, it is of interest to observe the methods employed by owners and builders for adding weight to underwater lines for construction purposes so as to increase stability and, in certain instances, to increase protection against corrosion. In certain salt-water areas marine "borers" are so destructive to the steel that a concrete overcoat up to 2 in. thick has been used to prevent their contact with the pipe.

Possibly the oldest means of weighting pipe is the addition of cast-iron or concrete clamps, attached at intervals, to provide negative buoyancy. This method is effective for its primary purpose, viz., that of sinking the line; and it enjoys considerable use among builders of large-diameter lines. Although popular with some, others point out that a clamp, because of its concentrated weight on a very short section of the line, will promote fatigue, and will eventually develop a weak spot at or adjacent to the clamp. Construction men have objected to the use of clamps because they make the pipe more difficult to install, particularly where long sections have to be pulled or pushed in place; and corrosion engineers state that any addition to the outside of the pipe that has edges, however rounded, will promote corrosion by its eventual contact with the bare pipe. To overcome these bad points, efforts have recently been made to develop a system of continuous coating of heavy material applied on top of the corrosion protection that would evenly distribute the extra weight and facilitate handling. One company pioneered in this field during 1949 by developing and using a 2-in. overcoat of extruded concrete applied continuously, except at joints, which were left bare for welding and were somastic-coated after the weld had been made. This method proved very successful, and since then it has been used in other crossings. No doubt there is room for improvement; and already another mix, which contains heavier ingredients than concrete, has been developed; this allows for a thinner coat, and still provides the 15 to 25 per cent negative buoyancy desired by many in installing river pipe. One company recently selected 26-in. by 1⅛-in. wall pipe for a mile-long crossing of the Hudson River. The negative buoyancy of this was 27 per cent, and no additional weight was required for sinking. It was felt that the added cost of steel was compensated for by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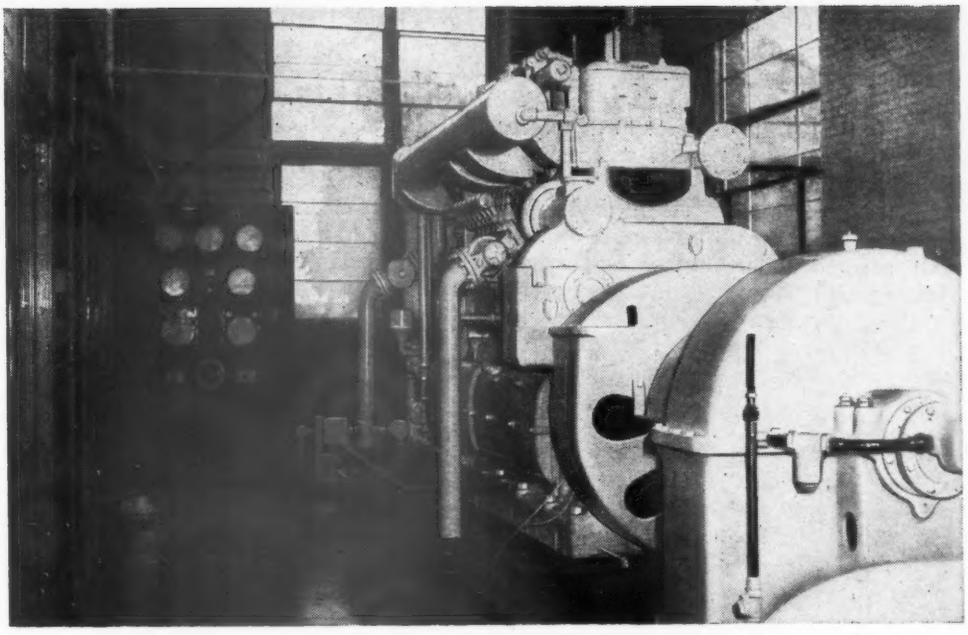

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The Barnett station is equipped with a single Alco diesel—replacing a total of 3 old-type engines. This rugged Alco diesel provides power for pumping 1,050,000 barrels a month through the 8-inch pipe line. It's a 6-cylinder, 4-cycle engine with 12½ inch bore and 13 inch stroke, rated at 810 hp and 650 rpm.

Such power and performance can be yours, too, if you install Alco Diesel Engines to meet your pipe line pumping requirements. Your nearest Alco engineer will be glad to help. Call him today at sales offices in New York, Beaumont, Chicago, Cleveland, Houston, Kansas City, San Francisco, Schenectady, St. Louis.

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Remember, since piston speed and journal travel per minute are both almost the same in medium speed and slow speed engines, wear is equivalent as well. Not only do you get unequalled dependability with Alco Diesels—you get long wear and low maintenance costs, no matter how difficult the service conditions.

ALCO DIESELS

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the safety gained, by the savings accomplished by eliminating outside weight, and by the ease of installation.

In many cases builders have submerged pipe by filling with water and displacing with oil; they have depended upon this additional weight to sink the pipe and hold it in place. This, of course, is less expensive in materials and construction; and, when the line is adequately covered under the stream, it is safe enough. However, in pipe larger than 10-in., any emptying of the line, or uncovering of backfill, can result in loss of the crossing.

Methods of Installation

Construction methods for underwater crossings vary according to the characteristics of the stream, the design of the line, bottom conditions, and the amount of trench required. For deep rivers with mud or silt bottoms, dredging is generally used to provide the trench; but, as previously pointed out, there is a limit to the depth that can be dredged. Recently the longest suction-type dredge in the world was used to excavate the underwater trench for a crossing of the Mississippi River. This was a dual installation, with one line bowed upstream and the other downstream. The lines were about 800 ft apart at the center; and 2 trenches, each about 150 ft wide and 15 ft deep, were dredged. This bottom width was necessary to allow ample space in which to land the pipe in the trench. A total of approximately 4,000,000 cu yd of dirt was moved during this project, with as much as 85,000 yards in a single day — indicating the tremendous earth-moving possibilities of large dredges. Dredges were also used in various other crossings, among them the Missouri and St. Lawrence.

The approaches can normally be excavated with draglines. In digging the approaches to a crossing, a long flat slope is desirable—thereby keeping the number of shop-made bends to a minimum. In addition to being difficult to place accurately, bends constitute a hazard for passage of the scrapers.

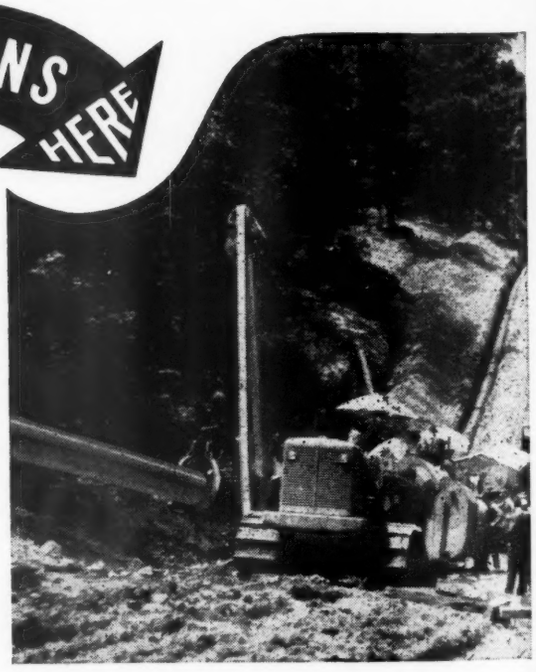
A departure from the dredge method of trenching was recently attempted on a crossing of the Hudson River between New Jersey and New York. A jetting arrangement was devised to provide the trench for a single 26-in. line going straight across. In this case the location of the site was restricted in choice because of the placement of a receiving terminal on the New York side. The Hudson River at this point has a silty, oozy bottom, and it was necessary to install the pipe about 25 ft under the bottom for protection from dragging ship anchors, and to insure a stable position. The jet consisted of a 30-ft joint of perforated pipe attached beneath the first joint of line pipe and connected by hose to pumps mounted on a surface barge. It was planned to assemble the pipe in sections on one side and, with the jet on the front of the first section, to pull the sections in from the opposite side as fast as the jet could provide depth. For about 1000 ft this was accomplished; but soon some clayey deposits were encountered, at about the 15-ft depth, which the jet could not displace. With a deadline for completion not far off, it was decided to dredge the remainder of the job rather than to try another time-consuming experiment, which, because of unfavorable soil consistency, might not prove successful. The value of jetting is recognized when certain conditions are present; but it is limited to highly porous soils, and its worth is governed by the abil-

First Aid for Defense

The National Security Resources Board has asked the Red Cross to undertake the training of millions in first aid, including all civil defense workers.

☆ ☆ ☆

PIPE LINE ECONOMY BEGINS HERE



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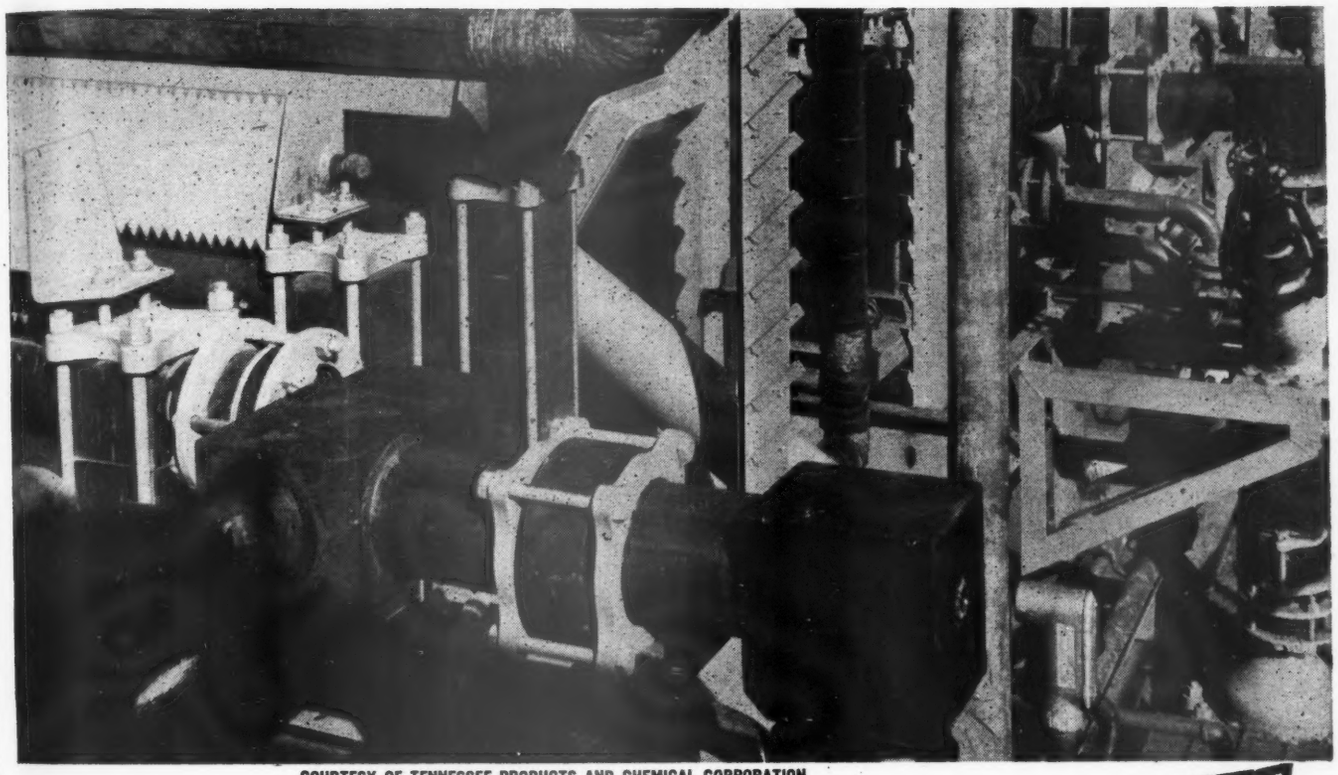
QUESTION:

What pipe handles ALL corrosives?



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★ **When you use "Karbate" impervious graphite, you don't need to use a variety of corrosion-resistant materials.**

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ity immediately to fill the displaced area with the object being buried.

On the St. Lawrence River, a straight-cross installation, winches on the dredge were utilized in pulling sections of line, from 800 ft to 1200 ft in length, from the shore into the stream. Assisting were tractors and sidebooms on shore, but the majority of the pulling power came from the dredge. No pontoons were used in this operation, but their use as a means of floating pipe over the trench is recognized. It might be mentioned here that an advantage of installing line straight across the stream is that successive strings of pipe can be pulled and/or pushed in place, thus minimizing handling. This is true up to certain lengths, but does not cover all crossings.

When an upstream or downstream catenary design is used, or when the crossing is so long that pipe cannot be pulled in, the pipe must be lowered in from floating equipment; it is well to take account here of the amount of equipment involved. In the aforementioned crossing of the Mississippi River the pipe, in 120-ft sections, was loaded on one barge and towed into the stream, where a ramp barge was anchored over the pipe-line trench. The pipe was transferred to the inclined ramp by a derrick mounted on a third barge. After each section had been placed on the ramp and welded to the preceding section, the ramp barge was moved forward by tugboat and winches — allowing the pipe to slide down the ramp into the water. Three lowering-in barges were stationed astern of the ramp barge on about 70-ft centers over the trench; and the pipe was lowered on a gradual slope, thus relieving stress from the pipe weight. A recording fathometer, installed on a small boat following the last lowering-in barge, was used to determine that the line was actually coming to rest in the trench. As the completed line neared the shore, pipe was lowered from the side of the barge ramp rather than from the ramp itself. Speed had to be maintained in this entire operation, as the trench began filling with silt and mud as soon as the dredging ceased. To emphasize the necessity of losing no time, two weeks after the pipe had been laid the river current had entirely refilled both trenches.

Inspecting and Testing

Inspection and testing are vital to the successful completion of a pipeline river crossing, and normally the owner furnishes inspectors for all phases —particularly pipe coating and welding. The welders who work on a river project should be the best available, and should be tested in advance for efficiency and workmanship. Many companies now prefer X-ray welds. In fact, of six major river crossings studied, X-rays were used on all. This method obviously provides the most positive check for imperfection of welds; and, consequently, the tendency to reinforce welds with sleeves is decreasing. Inspectors assure that the pipe or coating is not damaged during handling and installation, and that the line is placed in its proper position. The fathometer mentioned previously has served a good purpose in indicating the final position of the pipe. Even though the operating pressure at points of crossings will often be less than 500 psi, practically all lines are given a 1000-psi hydrostatic test.

For obvious reasons, locating engineers make every effort to avoid crossing sites that contain solid rock. It is true, of course, that sometimes there is no practical alternative, and in such instances the best must be made of a bad situation. Extra equipment for drilling, blasting, and removing rock is required; and additional precaution must be exercised in lowering-in the line, as well as providing protection from the rock base and backfill by adding rock shields, earth padding, or both. One saving factor in most rock crossings is the extreme stability afforded the finished line.

Use of Well-Points

In some parts of West Texas, central Kansas, and Oklahoma, pipeline construction personnel have had considerable trouble with subsurface water at points of river crossings. In some instances the amount of water underground exceeds that in the surface stream, and "well points" have been employed in an effort to dry up the working area.

This method of dewatering has been used for some time in different construction work, primarily subsurface foundations and installations; but its use in pipeline jobs seems to be fairly new.

A well-point system, in its simplest form, is a series of interconnected pipe, the points or bottoms of which pipe have been sunk into the ground to the approximate level of the strata which contain the water, and which are hooked up to a pump or pumps above ground. These pumps pull the water up and discharge it to an out-of-the-way location. The size and depth of the system would depend, of course, on the amount of water to be removed and its subsurface location.

As a general rule, these systems have been installed in locations where it was particularly desirable to put the pipe to an exact depth, and when it was felt that the cost of well-point installation was justified because it provided a water-free working area.

In many instances where small amounts of water are involved, a single line of 2-in. pipe on 2½-ft centers is installed to the desired depth of the upstream side of the proposed work, and it is operated continuously during the work. When one line is not sufficient to handle the volume, an additional line or lines must be utilized —either parallel to the original pipe or completely surrounding the working site, depending on the source and the flow of the water.

Some users have reported worthwhile results from well points in areas where shifting sands are present — maintaining that, after the water had been removed, the tendency of the sand to "close in" on the excavation was minimized. Many builders say that the satisfaction of working under dry conditions, and of always being able to see the bottom of their pipeline trench, is worth the price of a dewatering system. The use of points is, of course, most efficient when the surface water is negligible and can be diverted or removed — thus providing dry work from end to end, for all practical purposes, eliminating river crossing problems.

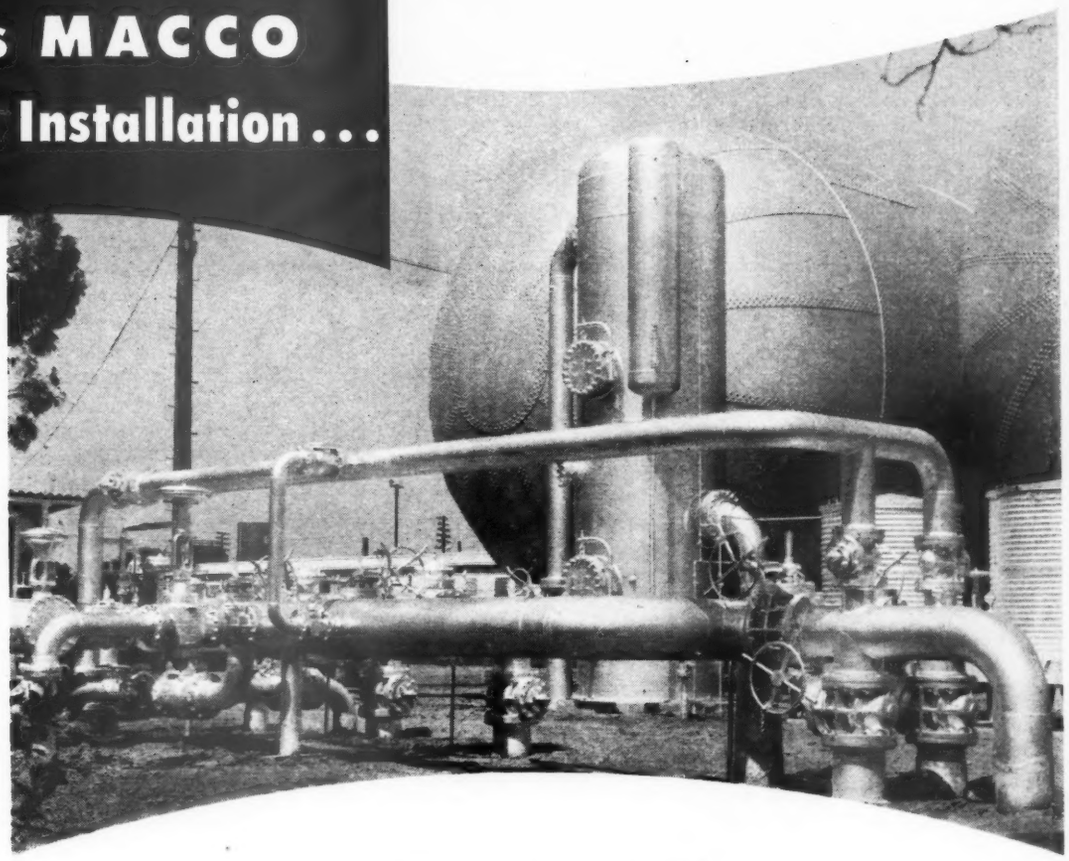
It must be remembered that the well-point idea is, in its original design, for conditions where *subsurface* water creates problems sufficient to justify water removal. It is taken for granted that this method for dewatering works best in sand and gravel, and least efficiently in non-porous formations such as clay. Inasmuch as the normal method of installing the system is to jet the small suction pipe to its desired depth, the presence of rock above the water level precludes any reasonable use of well points.

It is always possible, of course, to drill holes for the well points, but in most cases the expense would not be justified by the results.

Overhead Crossings

Although not discussed in detail herein, mention should be made of another method of crossing water. Many rivers or streams with very deep beds, but not very wide, can be successfully and economically spanned by overhead means. It is sometimes more practicable to do so using fixed supports or suspension-type "bridges" than to go under the stream. This type of crossing is usually at non-navigable streams of widths less than 500 ft. However, there have been, and will no

"NEAT" is the word for this MACCO Pipeline Installation...



To Macco's field engineers and crewmen, pipeline jobs are not necessarily simply stringing and trenching of pipe as ordered. The piping in the natural gas meter and regulator station shown above is a typical example. With the exception of the storage tanks in the background the entire above-ground system is Macco-engineered and installed. For large or small, simple or complex pipeline jobs on the West Coast — consult MACCO.

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doubt continue to be, some instances where wide, navigable rivers with certain stream and bed characteristics — such as an extremely unstable bottom, high-velocity currents, and varying water levels — make the construction and maintenance of a submarine crossing impracticable. In such cases elaborate bridging systems have been devised and employed, with considerable success. The cost of installing an overhead crossing of a navigable river is usually so high (from 10 to 15 times that of under-water crossings) that most companies prefer submarine crossings. In some instances lines have been attached to highway and railroad bridges across rivers. At Greenville, Mississippi, one gas company has practically bought a multi-million-dollar bridge across the Mississippi, on which it already has lines and is adding additional lines. Utilization of existing bridges, although no doubt practicable under certain conditions, is not widespread.

Conclusion

After having studied numerous submarine crossings by different companies, we are able to arrive at a pattern that is generally followed. Although no two designers are likely to choose exactly the same methods, it seems that a majority agree on the following points:

1. The pipe for a river crossing should have a ½-in. minimum wall thickness, and should withstand a tensile yield test of 50,000 psi, with a carbon content not in excess of 0.30 per cent — preferably an average of 0.25 per cent.

2. Considering the value of a river crossing, the best coating is none too good; and the author believes that a somastic-type coating is best.

3. It is wise, in large-diameter lines, to add sufficient weight to provide about 20 per cent negative buoyancy. It is the author's opinion that a continuous-weight covering is preferable to the clamp method.

4. When a river or body of water has very little or no current, the most practicable design is a straight line across. If the current is appreciable, an upstream or downstream catenary, or combination of the two, is favored. If dual lines are installed, they should be in separate trenches; and, if feasible, they should be far enough apart to prevent the loss of both lines, for a common reason.

5. If the pipe is to be laid straight across the stream, and if sufficient power is available, the easiest way to install is by pulling and/or pushing the pipe in successsive strings. If this is a catenary design of any appreciable length, the pipe must be lowered-in from floating equipment in straight sections short enough to allow the forming of the catenary after and during the lowering-in. For wide, deep rivers, a dredge has proved itself to be the most practicable and dependable means of excavating the trench.

6. All available tests should be applied before the line is lowered-in.

7. Never underestimate the power and danger from a river. Pick the best site available, and put your crossing in deep — bowed upstream, perhaps downstream, or straight across. Put it in coated or bare--weighted or not; BUT PUT IT IN DEEP!

Acknowledgment

A number of pipeline companies and contractors furnished information that was helpful in the preparation of this paper. Their assistance is gratefully acknowledged. They include: Mid-Valley Pipeline Company; Shell Pipe Line Corporation; Portland Pipe Line Company; Montreal Pipe Line Company, Ltd.; Transcontinental Gas Pipe Line Corporation; Magnolia Pipe Line Company; Latex Construction Company; Fish Constructors, Inc.; R. H. Fulton and Company, and Texas Pipe Line Company.

* * *

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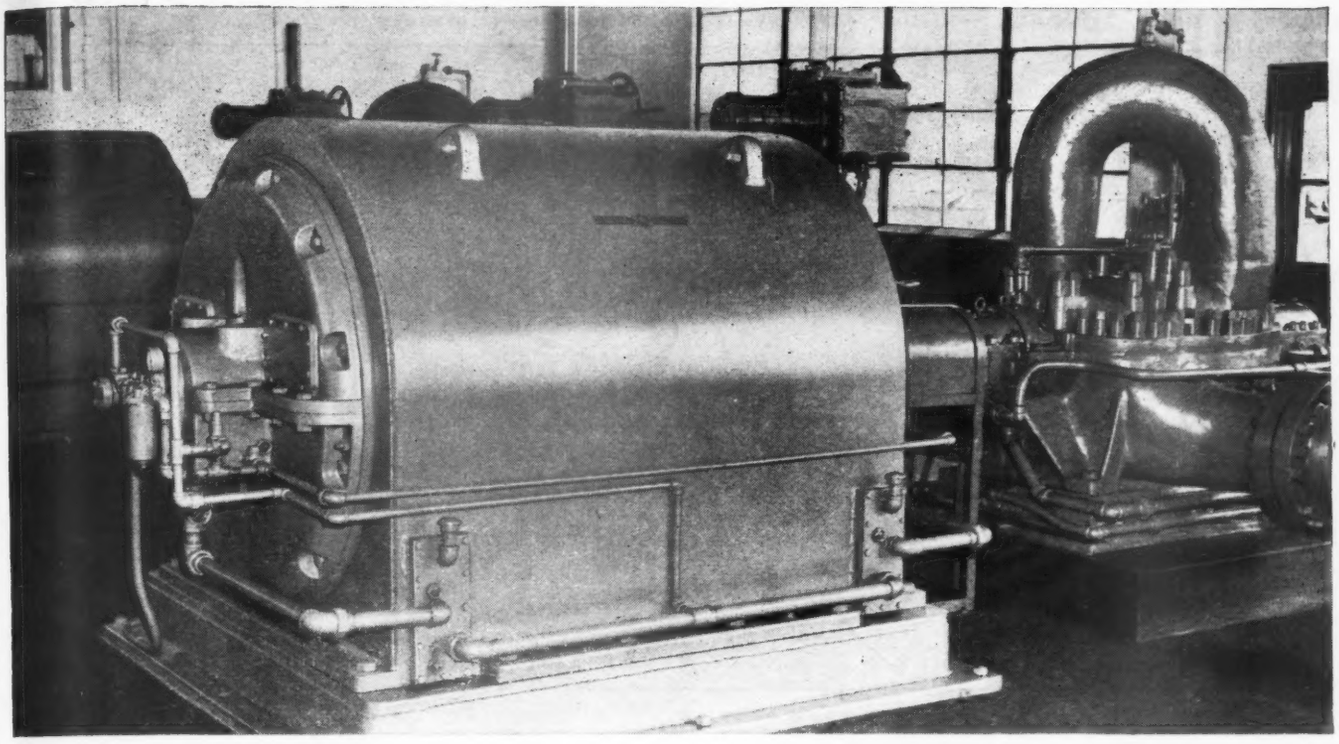
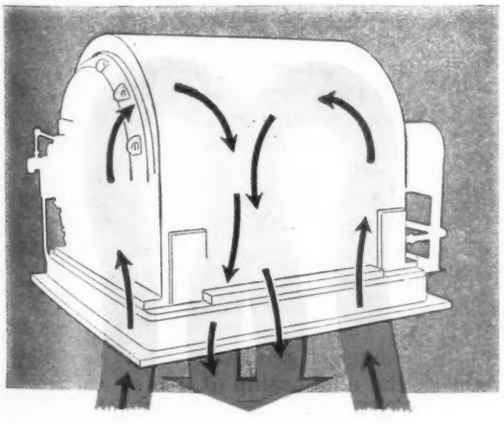


These two G-E forced base-ventilated motors—each rated 1500 hp, 2300 volts, 3600 rpm—drive centrifugal pumps in the Mayersville, Miss. station of the Mid-Valley Pipeline Company's 22-inch crude oil line. Two other stations in this 1000-mile line are similarly equipped.

All-enclosed cooling... all-around protection!

In new oil pipeline station, G-E motors require no extra equipment; separate motor-driven blowers remove motor heat, keep out hazardous gases



Simplified sketch shows how air inlet and outlet passages in motor's base all open directly down through the foundation to the source of ventilating air. By first starting a separate motor-driven blower, any hazardous gases are cleared from the main motor before latter is started.

Driving pipeline pumps that deliver 157,000 barrels per day, these two General Electric 1500-hp forced base-ventilated motors with separate motor-driven blowers combine both protective and low-cost advantages:

(1) Separate motor-driven blower—started up in advance—purges the main pump motor and duct system of any gases that may have accumulated during a shutdown period. It also removes heat quickly and effectively from the main motor during operation.

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These motors are part of a broad G-E line for every electrified pipeline need. Let a G-E pipeline specialist help you select the right motors for *your* pipeline, and write for bulletin GEA-5423 on electrification of oil pipelines. *General Electric Co., Schenectady, N. Y.*

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Everything you need to cut oil pipeline costs —ELECTRICALLY!

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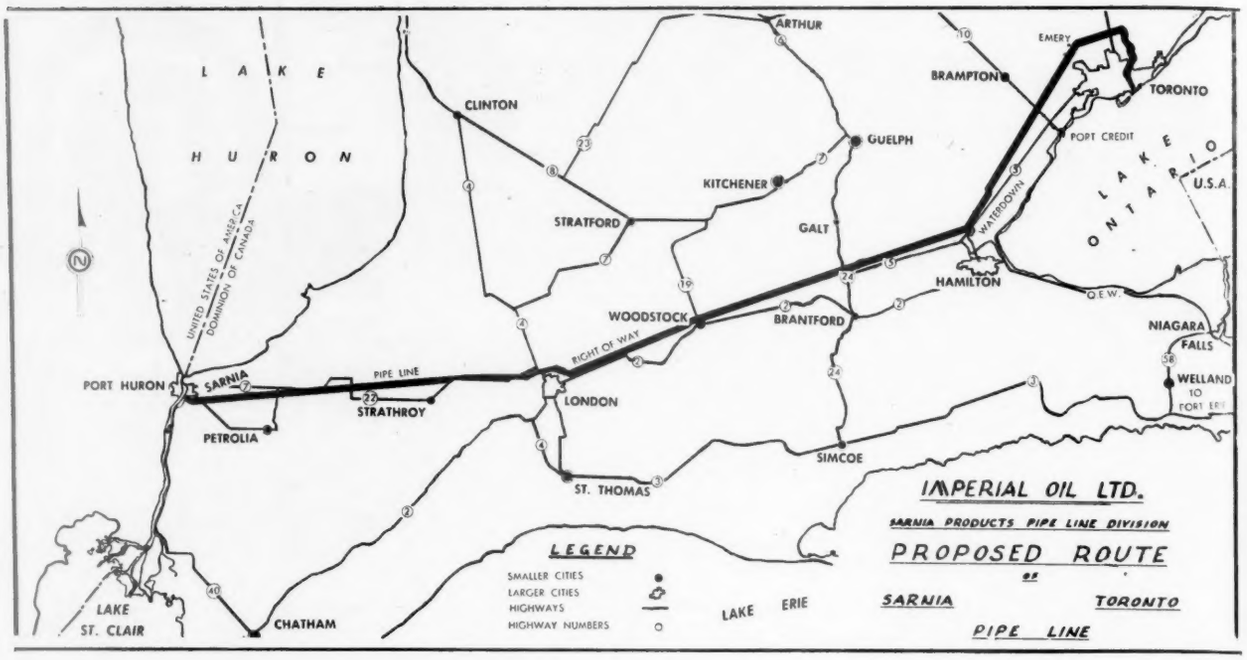


Sarnia — Toronto Pipe Line

Three major Ontario cities will be served by products line scheduled for operation in 1952

HARRY CHAPIN PLUMMER

THREE of Canada's vital centers of industrial defense—Toronto, Hamilton, and London—will be linked during the coming year (1952) by a 185-mile products pipe line with the strategically situated petroleum transshipment and refinery city of Sarnia, at the southern extremity of Lake Huron. Two of the delivery points on the new project are key ports on Lake Ontario, and Sarnia is the eastern terminus of the Interprovincial Pipe Line Company's system from Edmonton, Alberta, which provides tanker service by lake carriers from Superior, Wisconsin. Sarnia is the site of lately expanded refinery installations.

The Lake Huron port doubled its population—from 17,991 to 36,500—in the 10 years from 1942 to 1951 and last July became the scene of a $43,500,000 petrochemical pooling of the Imperial Oil Limited, the Dow Chemical Company of Canada Limited, and the Polymer Corporation Limited, with attendant huge scale plant construction, including a unit by the last-named corporation to produce synthetic rubber.

The Sarnia-Toronto pipe line, which will consist of about 125 miles of 12-in. and some 60 miles of 10-in., will have an initial throughput of 28,000 bbl per day. Its cost will be approximately $9,000,000, and it will have an operating staff of about 60.

The present marine terminals at Toronto and Hamilton, the latter Canada's major steel-producing city, now used by tankers limited to the Great Lakes navigation season of 7½ months, will be supplied by the pipe line, but in London a suburban site for a new terminal has been chosen to replace the existing plant. Two 6-in. take-off lines will feed the important Hamilton market, extending from Waterdown, about 6 miles distant, of which one mile will be under Hamilton harbor.

Officials of Imperial Oil Limited, the owners and builders of the new line, were faced with the alternative of supplying the three major Ontario cities by pipe line or building tankers and extra storage tanks. Costs would have been virtually the same by either method, but the decision to construct a pipe line was predicated upon the lesser quantities of steel than would be required by ships and tanks and the ability afforded the company to make more flexible supply arrangements. The pipe line operation affords the advantage of having no closed season and of permitting the delivery of gasoline, diesel and furnace fuels, and gas oils from the Sarnia refinery as needed. Otherwise, by use of tankers, the winter consumption of the various products would have to be estimated in advance and provision made by bringing in and storing before the close of navigation.

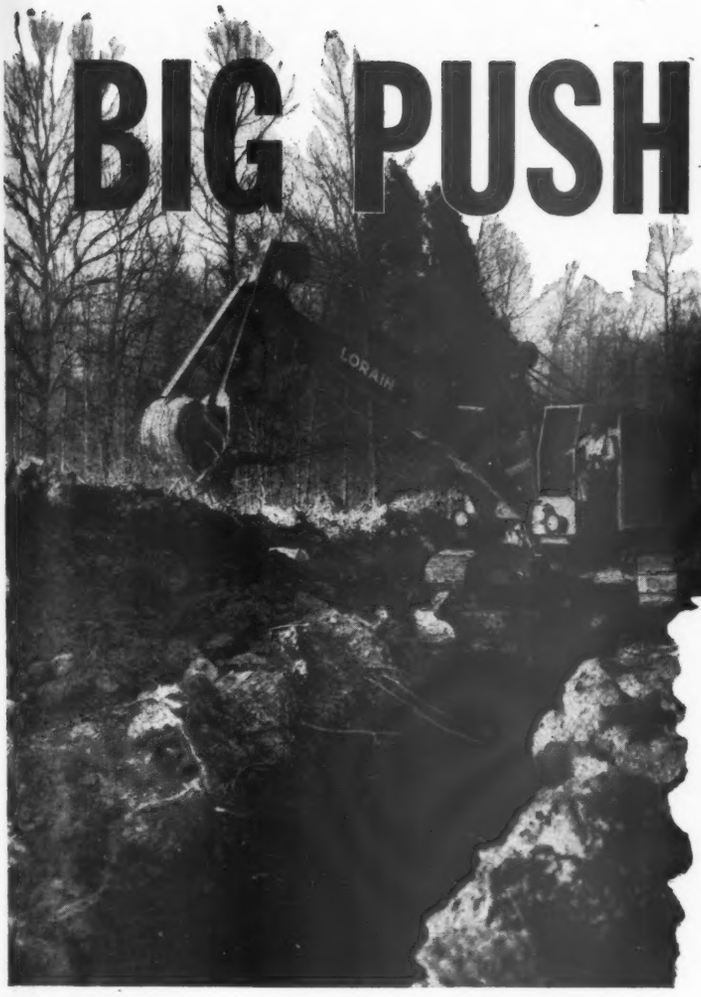
Aerial photographs formed the basis for a survey of the line, completed some months ago, and for the tracing of a tentative route. Then engineers went over the ground and changed the route to avoid such obstacles as water hazards and swamps. A detailed ground survey to locate the actual right-of-way, in most instances 50 ft wide, is now in progress.

The accompanying map shows the route as generally agreed upon and the relationship of the two chief focal centers of Ontario's industry and intensive Great Lakes steamship, motor, and rail traffic to the source of petroleum products, Sarnia. It also shows the position on the route of London, not only a manufacturing community but the dominant factor in the rich wine and fruit belt of southern Ontario, whose many farms are equipped with the most modern of agricultural implements, which require large amounts of fuel and lubricating oils.

The basic materials for the pipe line are now on order and the completion and opening to service is anticipated for 1952. ***

EXCLUSIVE

BIG PUSH FOR MORE SPEED ON PIPELINE CONSTRUCTION



LORAIN "PIPELINERS" HAVE WHAT IT TAKES FOR FAST, LOW-COST DITCHING

Here's the secret to speed on pipeline construction . . . Lorain Pipeliners with all the features that answer the needs of pipeline men! In both the ¾-yd. "Junior" and 1-yd. "Senior" Pipeliner Models, you get an extra-wide crawler designed to span the ditch with plenty of clearance to prevent cave-ins. ("Senior" models are 13 ft. wide —"Junior" models, 11 ft. 8 in. wide.) There is plenty of width in these crawler mountings to move on or off the ditch. Special pipeline dippers dig clean, vertical walls. No other machines can match all the built-in features of Lorain Pipeliners.

HAVE YOU SEEN THE PIPELINER MOVIE?

Your Thew-Lorain Distributor will gladly arrange a showing of this new movie — packed with scenes on pipeline jobs across the country. Write for his name today.

MOTO-CRANES "*HIGHBALL*" JOBS ALL ALONG THE RIGHT-OF-WAY

If you're looking for high-speed mobility to cover all jobs along the right-of-way, high-speed 30 m.p.h. Lorain Moto-Cranes are the answer. Moto-Cranes have multiple tire soft-ground flotation and tractive effort to negotiate rugged pipeline country. Available with 2 or 3 axles and 4 or 6 wheel drive. Let your Thew-Lorain distributor analyze your pipeline needs and fit them for speed and low-cost construction.

THE THEW SHOVEL CO., LORAIN, OHIO

THEW® LORAIN PIPELINER

Chart for Determining Capacity of Tanks

THE accompanying chart will be useful for determining the number of cubic feet in any cylindrical tank from 1 to 200 ft in diameter and 1 to 300 ft in height. The capacities vary from 2,000,000 to 10,000,000 cu ft.

Simply run a straight line across the chart connecting the height of the tank with its diameter and the intersection with column B gives the number of cubic feet instantly.

For example, if one has a tank 20 ft in height and 10 ft in diameter, what is its capacity? The dotted line drawn across the chart shows how it is done. Connect the 20 ft, Column A, with the 10 ft, Column C, and the intersection with Column B gives the answer as a little over 1500 cu ft. Figure it out with a lead pencil and it will be found that the correct answer is 1570 cu ft, which shows that the chart gives results that are remarkably close.

In case it is desired to know the volume of liquid of a given tank at a given time, Column A represents the depth of the content in feet and Column C the diameter, as before. The figures in Column B then represent the number of cubic feet in the tank.

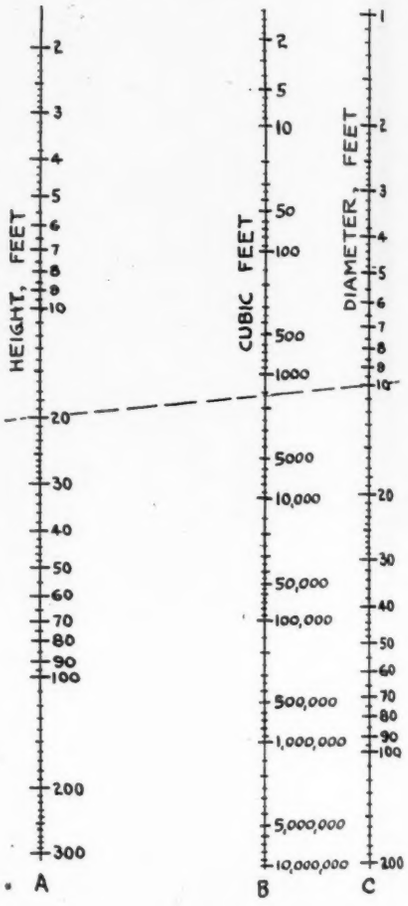


Chart for determining number of cubic feet in any cylindrical tank.

The chart may also be used backwards for determining the height to which a given tank should be built or the diameter it should be given for a capacity of any number of cubic feet. Or, it may be used for determining the height to which a tank should be built where the capacity and diameter are both known. In other words, where any two of the factors are known the third is easily found.

To convert cubic feet into gallons, multiply by 7.5.

To convert cubic feet into bbl of oil multiply by 0.1785.

To convert cubic feet into liters, multiply by 28.3.

—W. F. S.

THE PIG WITH THE POKE — CLEANS PIPE LINES

THE VERY LATEST

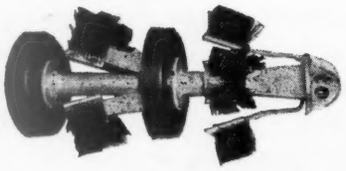
Williamson Pipe Line Pigs*

FOR CLEANING

NATURAL GAS PIPE LINES

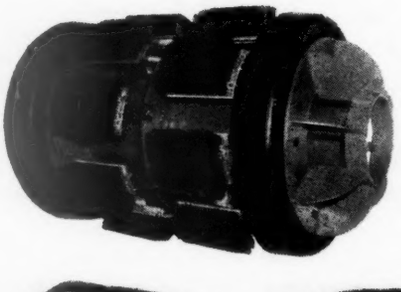
4" Size—TYPE JRN—2" to 4" sizes will pass 1½ R-90° Bends. No valves other than full diameter thru port valves.

Use TYPE SCN-51 for 6" size.



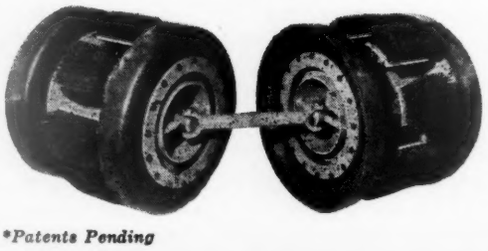
8" Size—TYPE WC-11—8" to 14" will traverse 6 foot radius field bends, full diameter side openings at 45°.

SPRINGS COMPENSATE for BRUSH WEAR.



20" Size—TYPE GP-2—16" to 30" 200 lb. SPRING forces the brushes against pipe wall—COMPENSATING for WEAR. Will traverse round opening gate or plug valves.

SPRINGS and BRUSHES are identical and interchangeable for all types and sizes of GP-PIGS.



24" Size—GP-3—18" to 30" sizes will pass 1½ R-30° bends. SPRINGS COMPENSATE for BRUSH WEAR ASSURING full section cleaning efficiency. GP-3 consists of two Type GP-1 Pigs. Each unit may be used as individual pig.

Patents Pending

T. D. Williamson, Inc.

TULSA 9, OKLAHOMA

Koppers Bitumastic Enamel being machine-applied

Most effective barrier against corrosion —BITUMASTIC® ENAMEL

KEEP moisture away from pipe-line surfaces with a protective coating and you prevent corrosion. It's as simple as that, in theory. In actuality, though, there's more to the story . . . *ordinary* coatings just can't keep out moisture, year after year.

But Bitumastic Enamels can!

These durable enamels are processed from a base of coal-tar pitch, *making them actually impervious to moisture.* They make a tight bond with the pipe. They do not disintegrate with age. They are chemically resistant to soil elements, and maintain continuously high electrical resistance.

And these qualities pay off. Many of this country's pioneer oil and gas pipe lines—laid in the 1920's—are still giving good service today, thanks to the effective protection provided by Bitumastic Enamels.

Protect your pipe lines, the sure way, by specifying "Bitumastic Enamels." Your Koppers representative will give you complete details and estimates.

Bitumastic Enamels soon available from Koppers new California Plant!

As soon as present construction work is completed, Koppers will be able to supply Bitumastic Enamels from a new plant at Fontana, California. The plant is being built to give you better service in the West.

KOPPERS BITUMASTIC ENAMELS
REG. U.S. PAT. OFF.

KOPPERS COMPANY, INC., Tar Products Division, Dept. 951-T, Pittsburgh 19, Pa.

DISTRICT OFFICES: BOSTON, CHICAGO, LOS ANGELES, NEW YORK, SAN FRANCISCO AND WOODWARD, ALABAMA

Clamp for Pipe Welding

WHEN WORKING with pipe, it is frequently desirable to have some form of clamp for holding sections of pipe. Many types of clamp can be made. Some are clamped over the pipe end; others require temporary welds. Here is a clamp that is inexpensive, easy-to-make, and easy to attach. Fig. 2 gives dimensions for making clamps suitable for most sizes of pipe.

The clamp shown here consists essentially of two parts, the collar, which clamps to the pipe wall, and the supporting rod, which carries the load when the pipe is being hoisted. Both parts are easy to make and assemble. Here's how to do it:

The collar is formed from a section of steel bar. Dimensions for this bar are given in Fig. 2. After cutting the bar to proper length (L), place it over a section of pipe on which the clamp will be used. By alternately heating with the blowpipe and pounding with a hammer, shape the bar to the contour of the pipe. After the bar has been shaped properly, bend the ears by placing the ends of the bar in a vise. (E) in Fig. 2 shows the amount the ear should extend after bending. Dimensions for the bolt holes are shown in column (F). These holes may be pierced with the cutting blowpipe or drilled. Place the holes as close as possible to the bends in the collar, allowing enough space for the head of the bolt and the nut. This assures maximum gripping pressure over the greatest area of pipe without bending the ears.

The diameter of the supporting rod is determined by the size of the pipe being handled. Bend the rod to the shape shown in Fig. 1 and weld the ends to the collar.

This is just one type of pipe clamp that can be made. By using your imagination, you can vary and improve this design and make a clamp suitable for your work.

This material was made available by the Linde Air Products Company.

* * *

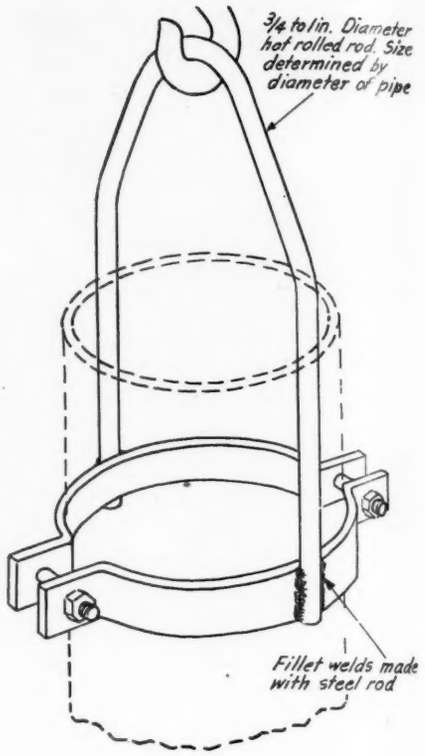


FIG. 1. This type of clamp will be found satisfactory for practically all pipe-handling applications. It can be made in a short time from scrap material.

Size of pipe, in.	Diameter "A," in.	Length of bar "L," in.	Width of bar "C," in.	Thickness of bar "B," in.	Space between ears "D," in.	Length of ear "E," in.	Bolt size "F," in.
3	3.50	9	1½	¼	½	2	⅜
4	4.50	10⅝	1½	¼	½	2	⅜
5	5.63	12	2	¼	½	2	½
6	6.625	14	2	⅜	¾	2	½
8	8.625	17¾	2½	⅜	¾	2½	½
10	11.750	22½	2½	⅜	1	2½	½

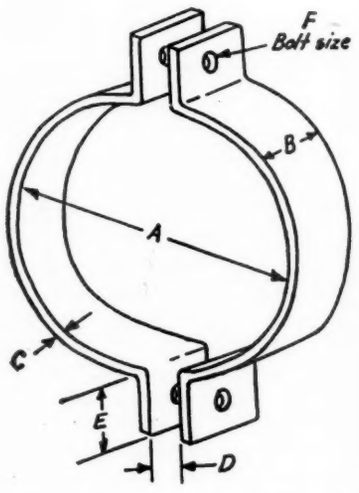


FIG. 2. Dimensions for making the clamp are shown here.

API Releases Tentative Bulletin on Lease Tanks

The Division of Transportation of the American Petroleum Institute announces the publication of a tentative bulletin on recommended practices in the setting, connecting, maintenance, and operation of lease tanks.

The bulletin was designed to meet an industry need for a reference booklet or bulletin on generally acceptable procedures in lease tank practices. The Division of Transportation expressed hope that the tentative bulletin will be studied closely by the industry and that constructive comment and criticism will be offered to guide its later revision.

The publication was produced by the Subcommittee on Lease Tank Practices of the Committee on Pipe Line Technology, which includes representatives of producers, pipe line carriers, and manufacturers. R. Charles Nicholson, Shell Pipe Line Corporation, is chairman of the subcommittee.

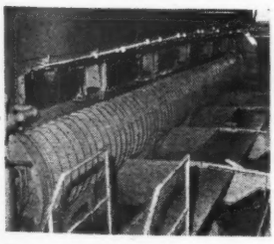
The tentative bulletin, identified as API Bulletin No. 1103, sets forth recommended practices in lease tank setting, connecting, maintenance, and operation. It represents a broad cross-section of industry opinion and seeks to accomplish the following objectives:

1. The correct measurement and proper sampling of crude oil by production pumpers or switchers and pipe line gagers;
2. The insurance that measured quantities of crude oil will be shipped and delivered to pipe line;
3. A reduction in the loss of oil volume or gravity by leakage or evaporation;
4. The physical safeguard of the limbs and lives of pumpers, switchers, and gagers, and the property of producers; and
5. The operation and maintenance of lease tanks along recommended lines.

The publication is divided into two parts. The first part deals with the recommended practices for setting and connecting lease tanks; the second part with maintaining and operating lease tanks.

The tentative bulletin may be obtained from the American Petroleum Institute, 50 West 50th Street, New York 20, New York, at 25 cents each.

Water diet for stronger pipe



AFTER Basalt-Kaiser Steel large diameter line pipe has been formed and welded, it is expanded by *water* under great pressure in this modern hydraulic expander.

Result: Increased strength, due to additional cold working. And unusual accuracy in concentricity, diameter and straightness.

Kaiser Steel pipe, manufactured to conform to latest API specifications—in diameters from ½ inch to 30 inches, and in lengths up to 55 feet—is being produced. Shipping points are Fontana and Napa, Calif.

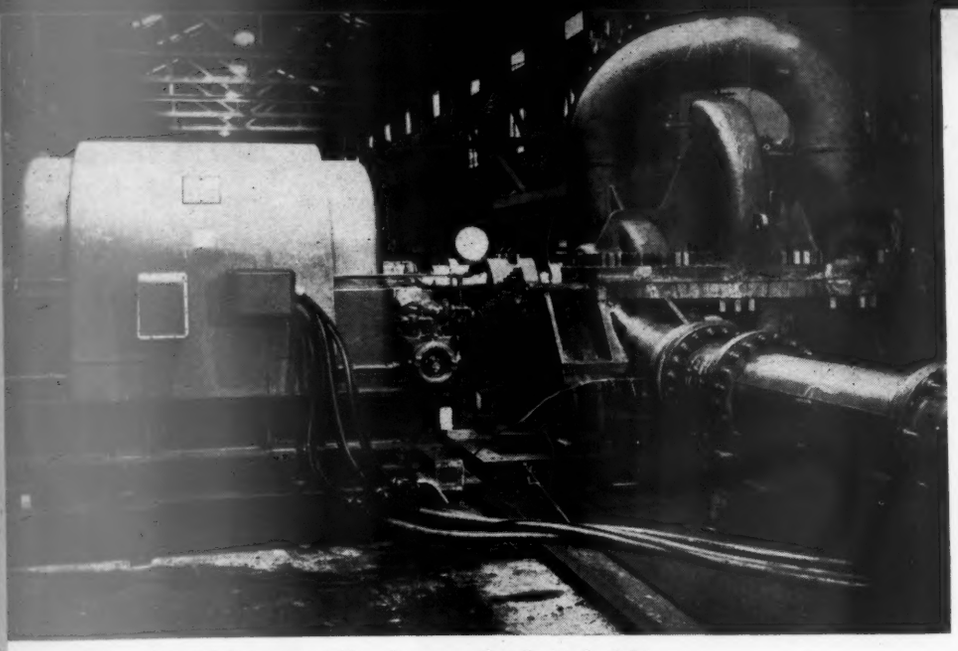
It's good business to do business with

Kaiser Steel

KAISER STEEL PIPE SPECIFICATIONS • All pipe manufactured to latest A.S.T.M. and A.P.I. specifications

Type	Diameter	Length	Wall Thickness	Shipping Point
Continuous Weld—Threaded and Coupled	½" to 4" nominal I.D.	Uniform 21'	Standard	Fontana, Calif.
Continuous Weld—Plain End	2⅜" to 4½" O.D.	Up to 40'	Standard	Fontana, Calif.
Electric Resistance and Fusion Weld—Plain End	8⅝" to 22" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser
Electric Resistance Weld—Plain End	5⅝" to 12¾" O.D.	Up to 55'	.188" to .400"	Fontana, Calif.
Electric Fusion Weld—Expanded—Plain End	24" to 30" O.D.	Up to 40'	.188" to .500"	Napa, Calif.—Basalt-Kaiser

Prompt, dependable delivery at competitive prices • KAISER STEEL CORPORATION Los Angeles, Oakland, Seattle, Portland, Houston, Tulsa, New York



Shop view of large centrifugal pump, the first of eight, taken at the time official tests were made at Oakland, California.

Biggest U.S. Oil Pipeline Pump

First of eight to be delivered to Basin Pipe Line system, is tested at Oakland, California

FIRST of the eight largest centrifugal pumps ever built for oil pipe line operation in the U. S. was tested recently at the Oakland, California, plant of United Centrifugal Pumps. L. F. Scherer, assistant general manager of The Texas Pipe Line Company, and Roy Olbrich, acting assistant chief engineer, were on hand to observe the tests prior to shipment of the units to that company's Basin Pipe Line.

With a capacity of 350,000 bbl per day, and differential pressure of 550 psi, the pump is driven by a 3000-hp electric motor, also the largest ever built for use on U. S. pipe lines. The 14-in. pump employs double suction on the first stage, and opposed impellers on second and third stages to achieve axial balance, with double volute design for radial balance.

The tests were also observed by P. D. Phillips, chief engineer, Humble Pipe Line Company; H. A. Johns, assistant chief engineer, West Texas Gulf Pipe Line Company; S. L. Westlake, assistant chief engineer, Magnolia Pipe Line Company; Gene Hunt, Service Pipe Line, engineer; D. J. Condit and Gray I. Morriss, Mid-Continent area representatives for United Centrifugal Pumps.

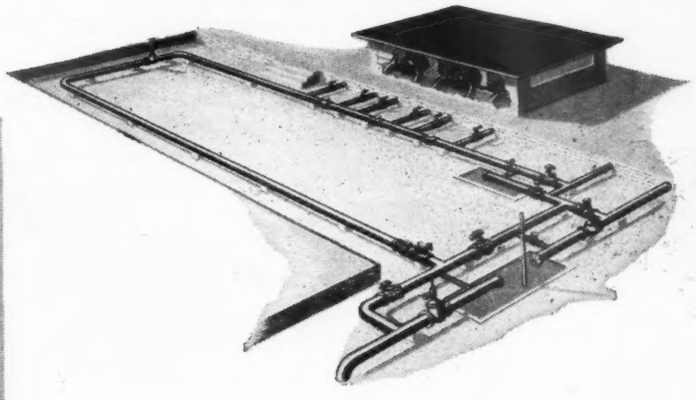
Conducted according to the Hydraulic Institute Code, the pump was tested with water, utilizing United's 50,000-gal. test tank. Capacity was measured by calibrated Venturi, and power by calibrated wattmeters. Pressure gages were calibrated before and after the tests. The test run was maintained for approximately one and one-half hours.

Designated as Model BFD-E, two of the 14-in. 3-stage pumps will be installed at each of four Basin stations: Hamlin and Seymour, Texas, Comanche and Norman, Oklahoma. Twenty single-stage14-in. pumps are also being completed for installation at other points on the same line. Four single-stage units and 12 two-stage United pumps are also being built for operation on Shell Pipe Line Corporations' Ozark System, comprising the other half of the Basin and Ozark Pipe Line System extending from Jal, New Mexico, to Patoka, Illinois. Sixty-six pumps have been in operation on the system for some time. The new units will increase capacity by approximately 100,000 bbl daily on The Texas Pipe Line Company line, and by 68,000 bbl daily on the Shell Pipe Line Corporation section.

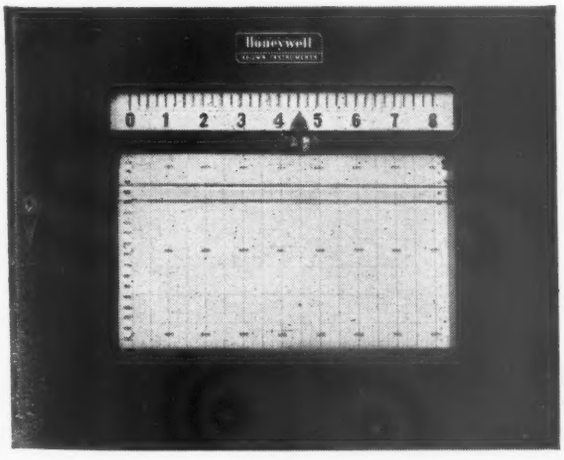
Under the direction of Val Lobanoff, chief engineer, and D. Pronzato, assistant chief engineer for United Centrifugal Pumps, the tests were conducted by United's test engineer, Clayton Nehring. Officials of the company present for the event included Bertram S. Booth, president and general manager; Roland Poinsett, secretary-treasurer and assistant general manager; Harold Booth, vice president and purchasing agent; John Re, sales manager, and Lawrence J. Viale, assistant sales manager. ★★

L. F. Scherer, assistant general manager, Texas Pipe Line Company, checks bearing temperature during test run. Others are B. S. Booth, president, United Centrifugal Pumps, and P. D. Phillips, chief engineer, Humble Pipe Line Company.

Pipeline pumping units overheating?



HERE'S *REAL* PROTECTION AGAINST EXCESSIVE TEMPERATURES



PIPELINE pumping units represent a substantial investment, and they pay for themselves only so long as they are kept in continuous operation. It is vital, therefore, that the centrifugal pumps and motors be protected from damage caused by overheating . . . not only are repairs costly, but downtime means a serious loss of revenue.

The *ElectroniK* Strip Chart Potentiometer provides the most dependable safeguard available for these valuable units. Here are the more important reasons why:

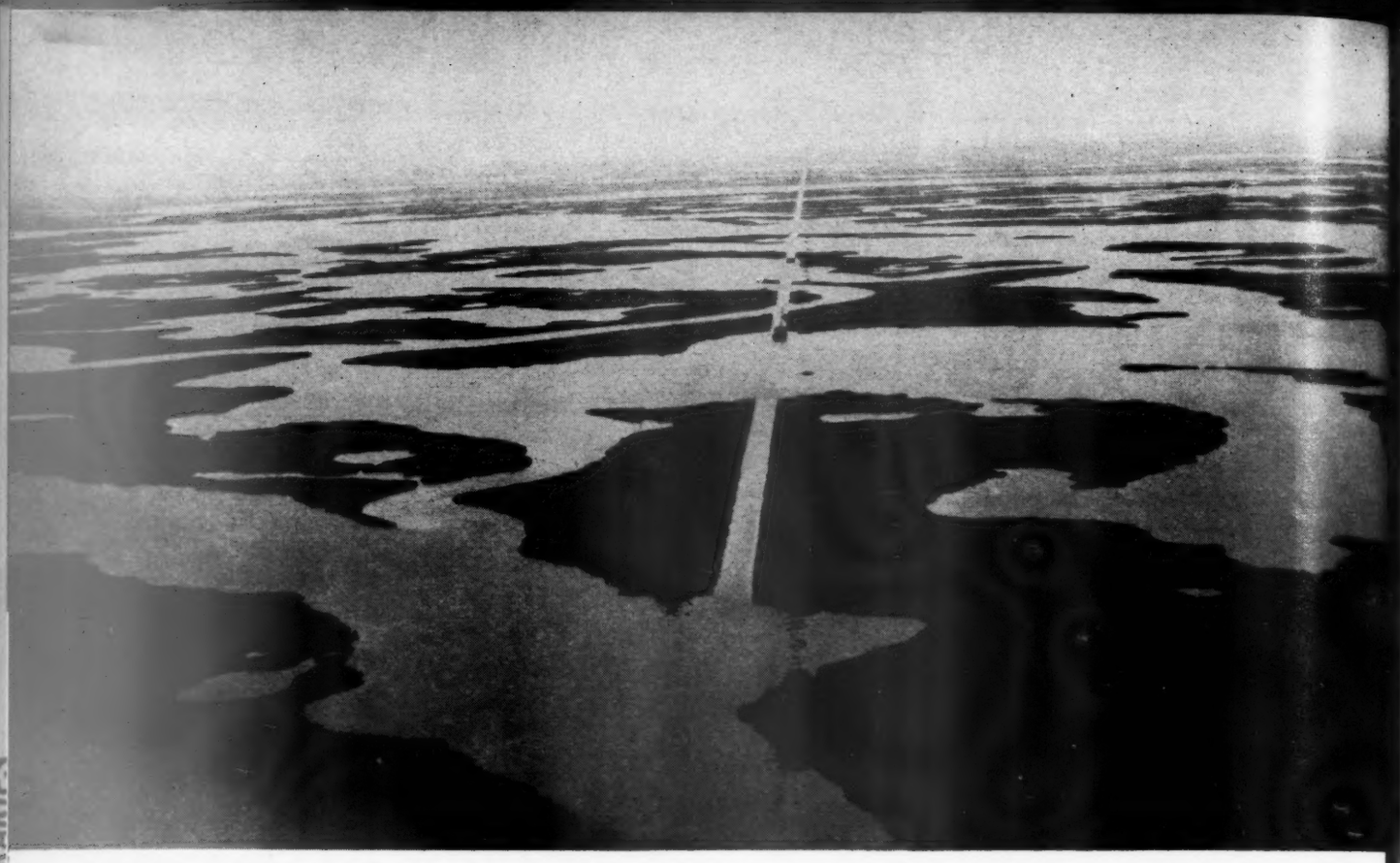
- *Up to 16 records on one chart. These may be temperatures of pump bearings (inboard and outboard), pump glands (inboard and outboard), pump case, motor bearings (inboard and outboard), motor windings at different locations, etc.*
- *Up to 8 different alarm points can be provided on each instrument for any recorded temperature.*
- *"Holding-in" relays require but momentary switch contact to energize an alarm circuit . . . instrument passes on to measure and log other points.*
- *Continuous recording indicates trends toward overheating.*
- *Small thermocouples or resistance thermometer bulbs can easily be installed in pump and motor parts.*
- *Continuous Balance measuring system with electronic non-cyclic balancing—not mechanical in operation.*
- *Unaffected by vibration.*

Data Sheet 7.2-4 provides complete details. Write for your copy today and for a copy of Data Sheet No. 7.2-1 on "Interlocked Suction and Discharge Pressure System." Call in our local engineering representative for a discussion of your needs.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4475 Wayne Ave., Phila. 44, Pa.

MINNEAPOLIS **Honeywell**

Brown Instruments



Straight as an arrow, the right-of-way for a new 16-in. natural gas pipe line crosses the soggy Mississippi River delta to bring fuel for a new aluminum reduction plant at Chalmette, near New Orleans. Filled with water, the ditch looks more like a canal.

P 623.

LAYING PIPE IN DELTA SWAMPLAND

Million dollars a mile is cost of gas system at mouth of Mississippi River

PIPELINE crews become sailors to lay 90 miles of line from oilwells at the mouth of the Mississippi River to the new Kaiser aluminum reduction plant near New Orleans, Louisiana. This line crosses the big river at two places and parallels it so closely in others that the men on the tractor seats can watch the big ocean-going ships steaming up the river to New Orleans.

In terms of "inches," the men of Brown and Root, Inc., who sail their boats and barges through the marshlands and floating islands that form the delta of Old Man River, have the "Wettest Inch."

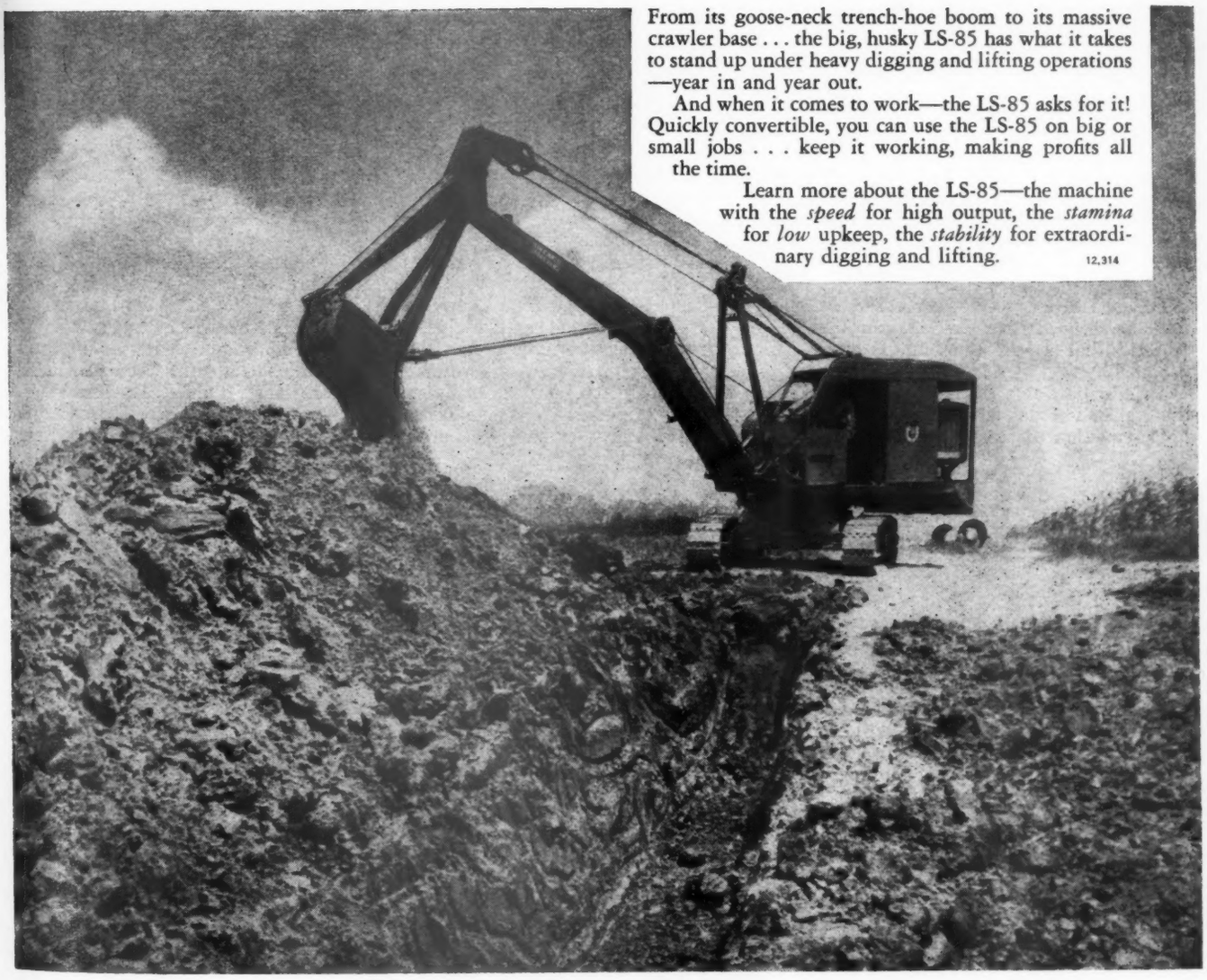
The principal reason for this line being built at a cost that may easily exceed a million dollars a mile is aluminum. At the present time, high-grade

With soggy ground as a base, an International TD-18A crawler holds the pipe as welders put on the final bead at the Venice location.

Here's why operators call the LS-85 the

SUPER 3/4 YD. SHOVEL-CRANE!

- Heavy-duty, all-welded construction..
- Designed to assure short, positive turns in steering
- Wide, long frame for ground-hugging stability
- 13″ ground clearance — nothing to snag or foul..
- Fully convertible for all attachments
- Service and repair parts stocked by your local distributor



From its goose-neck trench-hoe boom to its massive crawler base . . . the big, husky LS-85 has what it takes to stand up under heavy digging and lifting operations —year in and year out.

And when it comes to work—the LS-85 asks for it! Quickly convertible, you can use the LS-85 on big or small jobs . . . keep it working, making profits all the time.

Learn more about the LS-85—the machine with the *speed* for high output, the *stamina* for *low* upkeep, the *stability* for extraordinary digging and lifting. 12,314

LINK-BELT SPEEDER
CORPORATION

Builders of the most complete line of cranes, shovels and draglines
CEDAR RAPIDS, IOWA

Air view of the operation near Delacroix, Louisiana. Putting down pipe is a water-borne job here. Twenty-two men form the crew and three barges are tied together. The crane has its own barge to which it transfers the pipe from the haul barges and then puts it on the main work barge where two welding stations are set up. The dope crew has a small barge of its own.

bauxite ore is brought by boat from South and Central American ports and unloaded at Kaiser's plant in Baton Rouge, Louisiana, for primary extraction. For final reduction, it is shipped to the Northwest, where there is an abundance of electrical power. Then it must be shipped back East again to the factories that use the aluminum in their product.

To eliminate this high-cost shipping, the Kaiser Company is now building a final reduction plant near New Orleans at Chalmette. The site is a portion of the battlefield where Andrew Jackson defeated the British in the War of 1812. Low-cost natural gas, available here in unlimited quantities, will power turbines for electrical generators.

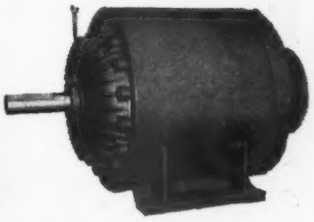
The United Gas Pipe Line Company supplies most of the natural gas used in the New Orleans area and got the order to supply the tremendous volume of gas needed for the new plant. Existing sources of natural gas could not meet this demand, so it was decided to build a new line to tap the coastal oil wells that were burning off gas as waste.

The new line was first plotted on the map with its beginning at the Westbay oil field on the gulf tidelands, just west of the ship channel entrance to the Mississippi River, crossing the river at Venice, Louisiana, then heading directly north along the gulf, frequently in open water, past Pointe La Hache and Delacroix to Chalmette. A feeder line was extended across the river at Pointe

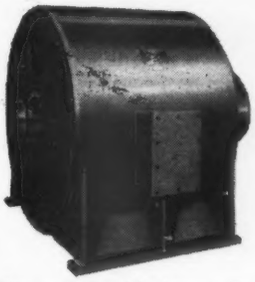
At Pointe La Hache, a barge is anchored firmly and pushes the pipe out from it, down the wet, gooey channel that was gouged out by a small dragline. These barges are 120 ft long and 27 ft wide. This one carries a crane with a 70-ft boom to lift the 40-ft pipe sections from the pipe barge, which is anchored alongside. Boom tractor—an International TD18A—with good spacers on its tracks so they won't damage the steel barge top, carries the pipe and holds it in place for the welders. When the section is welded, an International TD-14A tractor uses its winch to force the pipe out from the barge.

Where Pumping Must be Interruption-Free

600 hp, 1175 rpm motor driving crude oil pumps.



Construction used up to 800 hp, 3600 rpm.



Construction used for larger ratings.

ALLIS-CHALMERS Tube-Type TEFC MOTORS

MOTOR RELIABILITY and freedom from routine maintenance are now more essential than ever in the face of high costs and material shortages. For full-time full-capacity operation, you can rely on Allis-Chalmers *tube-type* totally-enclosed fan-cooled motors because:

1. Self-cleaning action — due to generous air flow through smooth, straight tubes — makes routine cleaning unnecessary. Besides, if cleaning is desirable, it can be done with the motor in operation.
2. Complete enclosure protects stator core as well as other electrical parts from corrosive conditions.
3. Full internal air circulation assures efficient, even cooling for maximum motor life.

170,000 Hp Already Purchased

In sizes from 250 to 2500 hp alone, purchases of these motors — introduced in 1946 — total more than 170,000 hp. And practically 50% of orders now are *reorders* from satisfied customers.

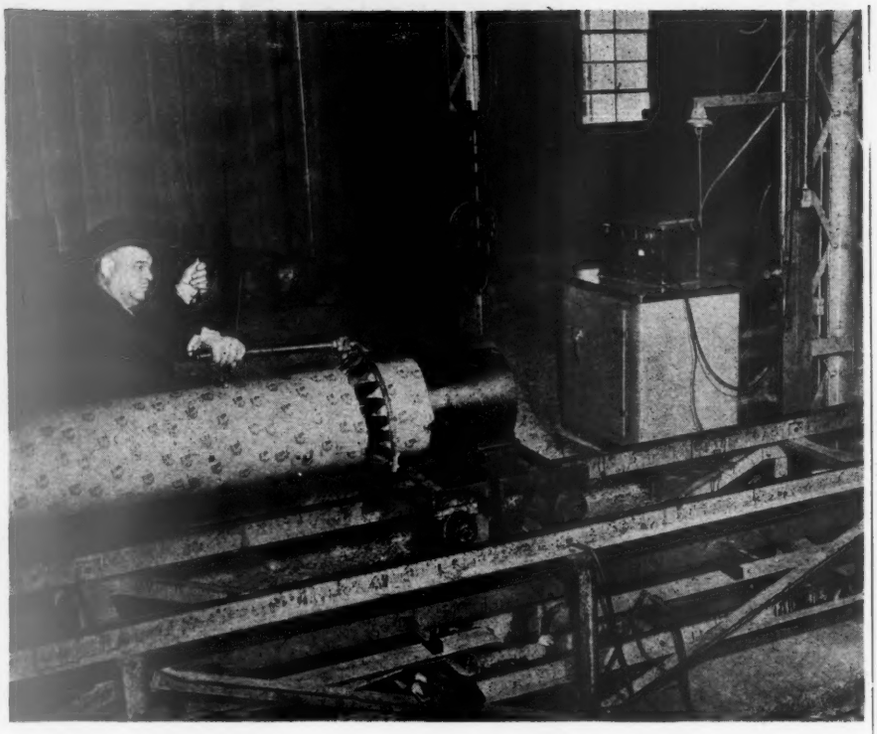
For more information about these operation-proved motors, call your A-C representative, or write for bulletins 51R7149 and 05B7150. Allis-Chalmers, Milwaukee 1, Wisconsin.

Standard and Explosion-Proof

Tube-type air-to-air heat exchanger construction may be obtained in standard and explosion-proof designs in sizes from 40 hp at 600 rpm to several thousand horsepower. Ratings up to 800 hp at 3600 rpm are available with Underwriters' labels.

A-3431

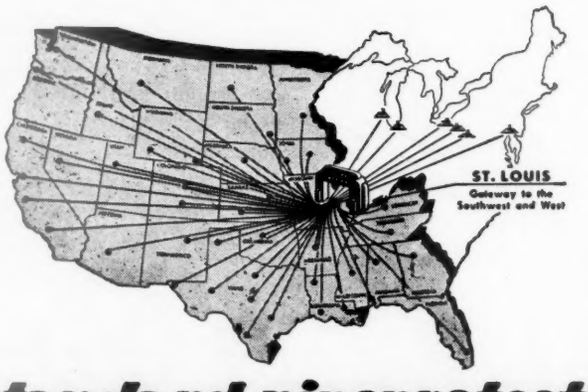
ALLIS-CHALMERS



EXACTING ELECTRICAL INSPECTION —EVERY PIECE OF C/W PIPE

STANDARD'S PROCEDURE . . . requires an Electrical Holiday Detector that produces a spark of constant value . . . metered to register the voltage of the spark itself and adjustable to any given voltage and so designed and built to prevent peak voltages and overloading . . . this exacting inspection of every piece of coated and wrapped pipe, followed by repairs if necessary, is your assurance that your specifications have been fulfilled.

COATING AND WRAPPING-IN-TRANSIT . . . permits stop-off for processing or storage at St. Louis without freight penalty. When you ship through the St. Louis gateway, you enjoy "through freight rates" instead of the higher combination rates generally used.



New Catalogue just off the press . . . Write for copy.

standard pipeprotection inc.
3000 South Brentwood Blvd. • St. Louis 17, Missouri

La Hache to reach several oil fields to the west.

The actual installation of the line was tackled by Brown and Root. This contracting firm started with the two river crossings last fall when the river was low. When these crossings were completed this February, the big job really began. Just about every known method of pipelaying is used and a few new ones improvised on the spot to fit the conditions.

Three basic systems are used. The few places where terrain is solid enough to support International boom tractors, the job resembles an ordinary pipe line.

Other sections will not support the tractors but will allow a lightweight dragline to gouge out a narrow trench for the pipe. In this operation, the work barge anchors at one end of the trench and pushes the pipe out from the barge, in some cases extending 5 miles of pipe from a single setting.

The third method is used in open water and where the islands are completely unstable. Some of these islands even drift with the wind and tide. A large channel is dredged out, 36 ft wide. The pipe end is anchored and then as new sections of pipe are welded on, the entire work barge is forced ahead in an action similar to a man poling a boat.

In the 90 miles of line, all but a few miles are through delta swamp where no gas line of this caliber has ever been attempted. Pipe lines that carry gas are lighter than water and float to the surface when placed in swampy land unless held down by iron river weights or the concrete coating. So in two yards on the Harvey Canal near New Orleans, the 40-ft lengths of pipe receive first a ½-in. thick coat of Somastic material to protect the metal from ground acids and corrosion, plus a layer of concrete ⅞ in. thick to bring the weight of a linear foot of 16-in. diam pipe to 152 lb. Then the pipe is loaded on the barges and towed out to the job.

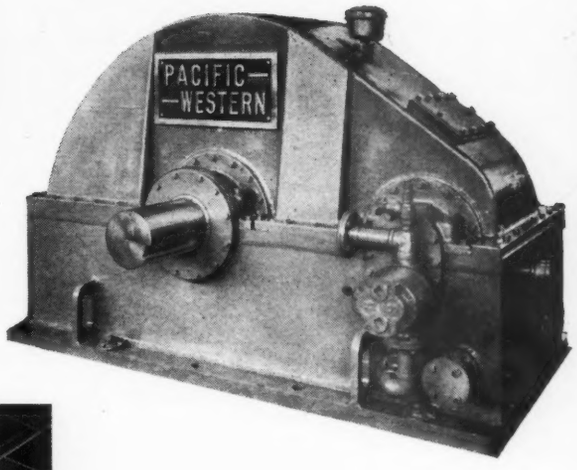
Oddly enough, the only work stoppage has been due to low tides when the pipe supply barges become stuck in the mud. The work barges soon exhaust their supply of pipe and the crews have a holiday fishing or hunting alligators until the water rises again. * * *

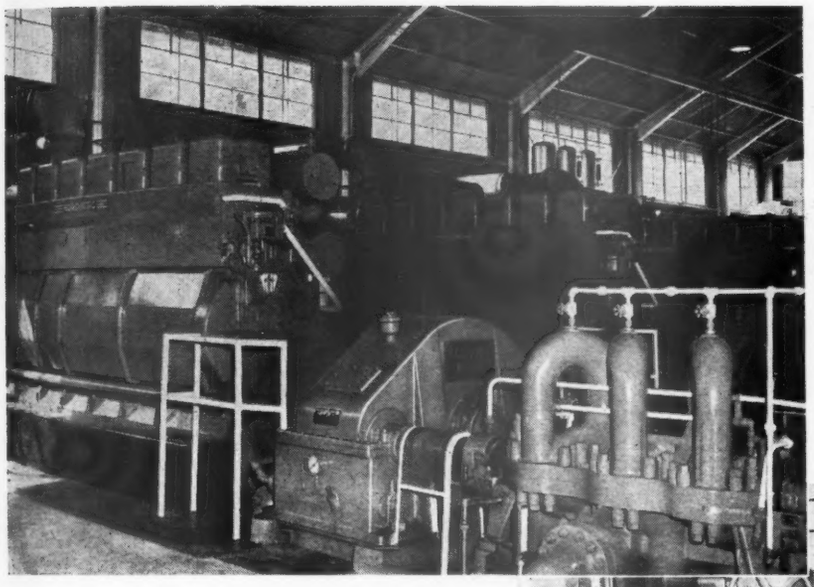
Information on Inhibitors Solicited by NACE Group

New information on inhibitors, whether derived from laboratory research or from field experience, is being collected by Technical Practices Committee 9 on Corrosion Inhibitors, one of the technical committees of the National Association of Corrosion Engineers. Contributions ranging in size from one-page observations to complete papers will be received by the committee chairman, Aaron Wachter, Shell Development Company, Emeryville 8, California. Papers received will be discussed critically by the committee and then issued in collected form, with discussion as a report of the committee.

WESTERN GEAR SPEED INCREASERS

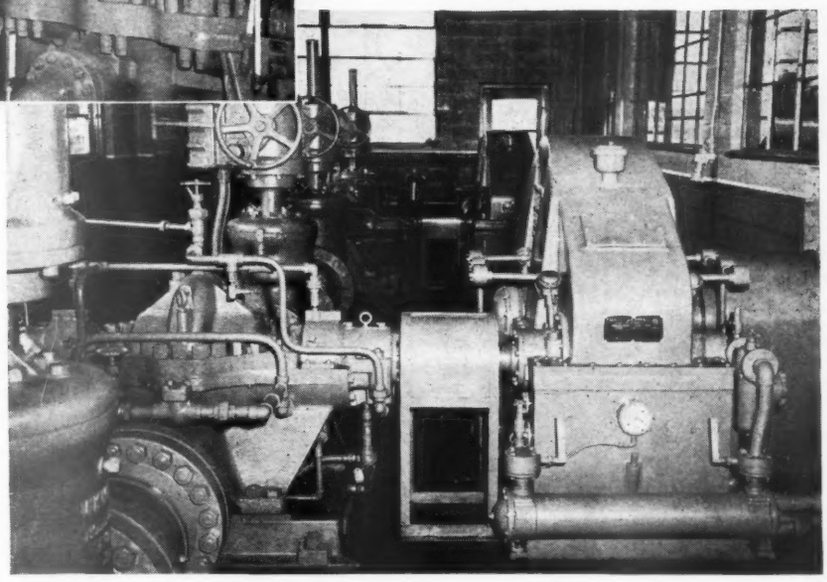
CHOSEN FOR BIG PIPELINE PUMPING JOBS





RICHFIELD PIPELINE

This new 112-mile, 14-inch oil line, with a capacity flow of 75,000 bbl. a day, has a rise in elevation of more than 3500 feet. Pumping capacity and dependability is obtained through six Pacific-Western speed increaser units. Diesel-power input of 1,000 hp at 450 rpm is stepped up to 3,600 rpm output.



MID-VALLEY PIPELINE

The largest speed-increasing units ever built for U. S. pipeline service were furnished by Western Gear for this 1000-mile pipeline. On the main line four units of 1,700 hp, and four of 1,200 hp are used to drive pumps to obtain 157,000 bbl. per day capacity. Extensions of the line will utilize additional units.

REQUIREMENTS FOR MODERN PIPELINE SPEED INCREASERS

Dependability for day-in, day-out continuous operation and efficient design are *musts* for this service. More than fifty years of gearmaking experience and exceptional engineering and plant facilities provide the background for the outstanding, modern line of Pacific-Western speed-increasing units.

5121

Write, wire or phone your nearest Pacific-Western office.

Plants • 417 Ninth Ave. S., Seattle 4, Wash.
2600 E. Imperial Highway, Lynwood, Los Angeles County, California
1035 Folsom St., San Francisco 3, Calif.
117 N. Palmer St., Houston, Texas

Representatives • 980 S.E. Oak St., Portland 14, Oregon
Room 211, Chamber of Commerce Bldg., Denver, Colorado
Engineering & Machinery Ltd., 1366 W. Broadway, Vancouver, B.C.

WESTERN GEAR WORKS

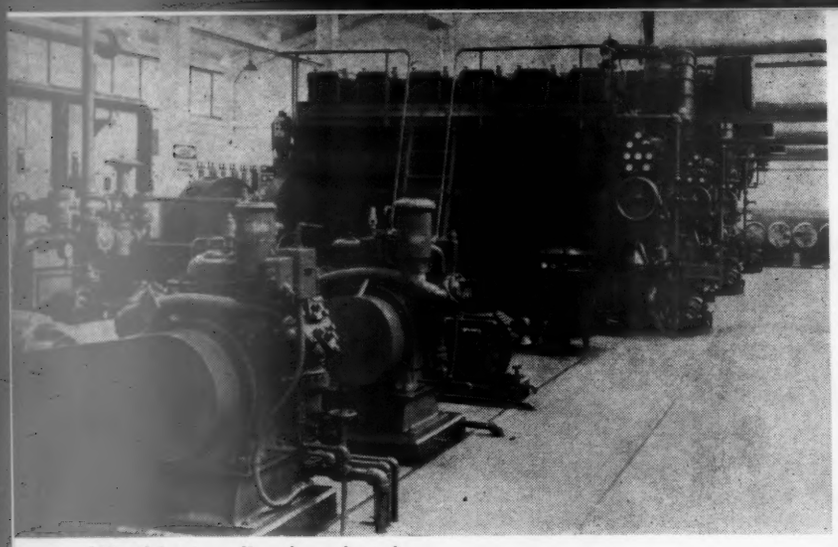
Manufacturers of PACIFIC-WESTERN Gear Products

Pacific Gear & Tool Works

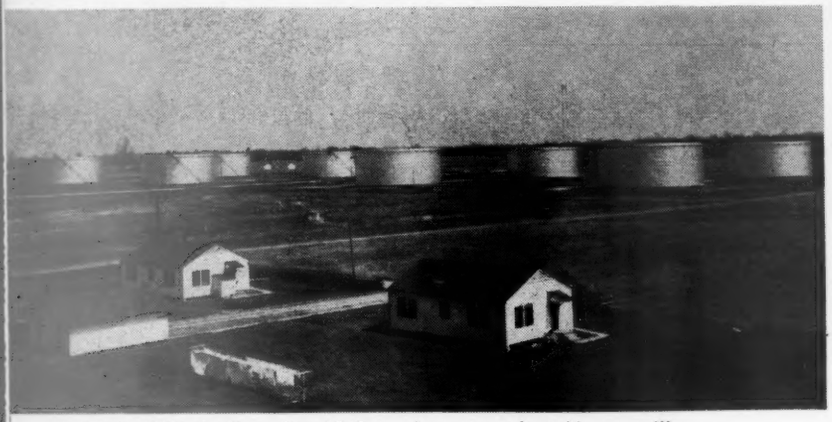
Plants: Seattle
San Francisco
Lynwood
(Los Angeles County)
Houston
Representatives:
Portland
Denver
Vancouver, B.C.

To obtain more information on products advertised see page E-43

PICTORIAL



Worthington diesel engines in a Trans Arabian Pipe Line Company station.



Eight 110-ft diam by 48-ft tanks erected at Mayersville, Mississippi, station of Mid-Valley Pipeline Company by Chicago Bridge and Iron Company. All are equipped with Horton double-deck floating roofs. Station cottages in foreground.

One of 114 microwave reflectors built by General Electric for Transcontinental. Project Engineer M. F. Davis finishes installation of the dipole prior to testing.

Construction men standing at Milpitas end of PG & E's "Super Inch" pipe line, near Llanada, California. They are: Dave Love, left, Jimmy Peck, R. H. Middleton, D. Leeper, A. L. Freeman, and E. Sellfors. Caterpillar diesel D8 tractors with Trackson sidebooms were used for laying pipe on the job.

Smith Contracting Corporation spread near Appomattox, Virginia, on Transcontinental line, using International diesel crawler tractors equipped with Superior sidebooms.

These men are playing an important part in laying Texas Illinois Natural Gas Pipeline Company's system to Chicago. They are Percy Clough, left, lowering-in inspector on Schedule 6; Clarence Shivel, superintendent of Spread 3 for H. C. Price Company, and Bill Buchanan, lowering-in foreman for Spread 3.

One of the problems encountered on the Texas Illinois project has been the many lines in place that must be crossed. Here a long section of the 24-in. line to Old Ocean field is put in place beneath a cross-line. (H. C. Price Company spread.)

Bechtel Corporation spread near Newport, Arkansas, on Texas Illinois Natural Gas Pipeline Company job. Two Lorain wide-track "Pipeliner" clamshells work at a drainage ditch crossing.

NEWS

Committees Named For NACE Meeting

Charles G. Gribble, Jr., local arrangements chairman for the 1952 Conference and Exhibition of the National Association of Corrosion Engineers, which will be held in Galveston, Texas, March 10 to 14, has announced the following chairmen and co-chairmen:

Printing Committee—Oliver Osborne, Dow Chemical Company, chairman; J. B. Chatelain, Freeport Sulphur, co-chairman.

Meeting Rooms Committee — Jack Battle, Humble Oil and Refining Company, chairman; Gordon Doremus, Cathodic Protection Service, co-chairman.

Registration Committee—A. L. Stegner, Tennessee Gas Transmission Company, chairman; Herschel Wood, Lebanon Steel Foundry, co-chairman.

Entertainment Committee—W. F. Oxford, Jr., Sun Oil Company, chairman; W. H. Stewart, Sun Oil, co-chairman.

Ladies Entertainment Committee — W. H. Waring, Johns Manville, chairman; Charles D. Brown, Aluminum Company of America, co-chairman.

Publicity Committee—Elton Sterrett, *The Pipeliner*, chairman; Frank H. Love, *The Petroleum Engineer*, co-chairman.

Housing Committee — P. E. Darling, Pan American Refining Company, chairman; Walter Janssen, Pan American Refining Company, co-chairman.

Sinclair Pipe Line Honors 35-Year Men

Sinclair Pipe Line Company recently awarded 35-year service pins and certificates to 73 employees who have contributed a grand total of 2794 years to the company. A series of dinners was held at which the awards were made.

The first dinner was at Kansas City, Missouri, for 21 eligible employees as follows: Charles E. Booth, Paola, Kansas; Michael J. Ohmes, Greeley, Kansas; John D. Kiefer, La Plata, Missouri; Willard C. Walden, La Plata; Jesse A. Shibley, Carrollton, Missouri; John A. Leach, Marceline, Missouri; Benjamin F. Guthrie, Carrollton; Clyde W. Carroll, Humboldt, Kansas; Floyd E. Dedman, La Plata; Charles E. Main, Sr., Kansas City; Lilburn L. Via, Moscow Mills, Missouri; Robert J. Wagner, Moscow Mills; John H. Kuntz, Shannondale, Missouri; Donn J. Chalfant, Griffith, Indiana; Leonard E. Westlake, Ponemah, Illinois; William C. Malloy, Ft. Madison, Iowa; John E. Tribbey, Galesburg, Illinois; Harry F. Rogers, Wilmington, Illinois; Burnham W. Holloway, Galesburg; William H. Chatham, Kernan, Illinois, and George Kutches, Kernan.

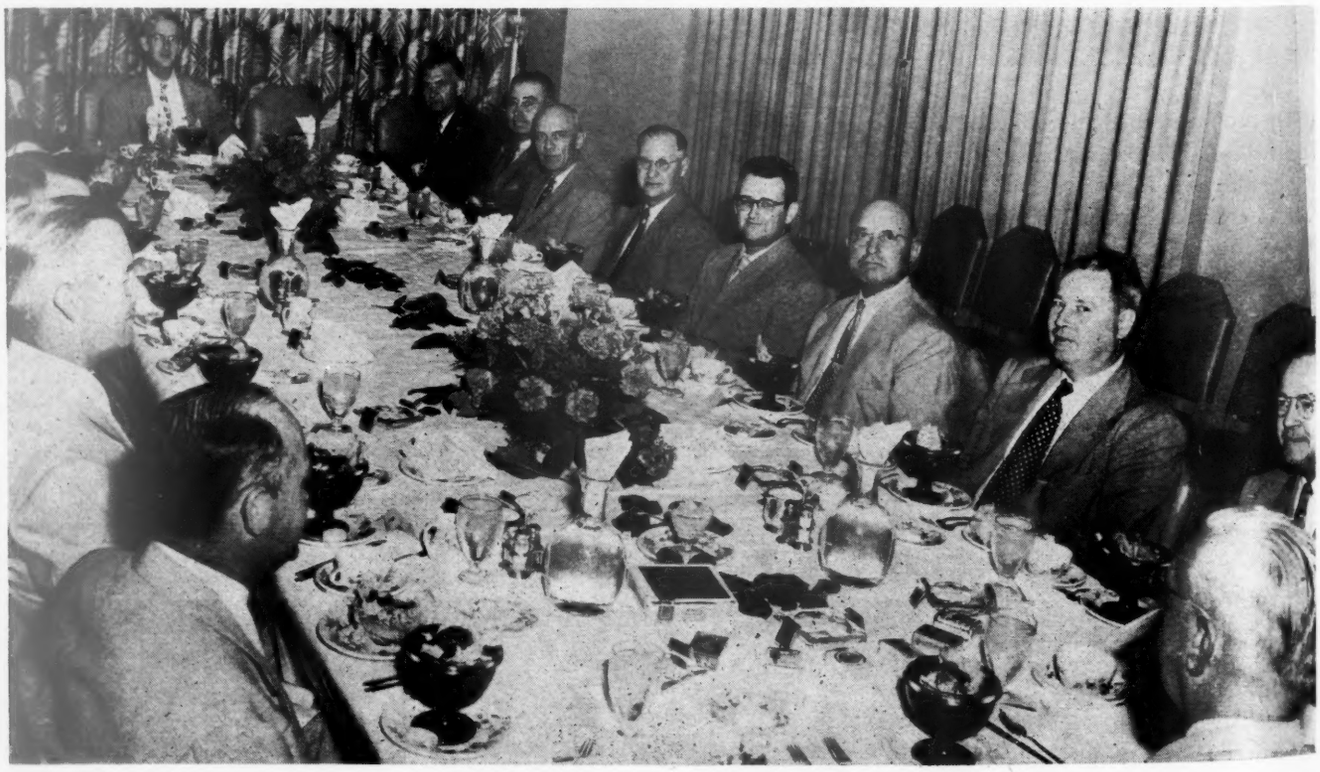
At Independence, Kansas, company headquarters, ten employees of the general office were honored. These were: Dennison C. Baker, Fred A. Crane, Henry S. Darby, William C. Goll, John A. Jackson, Leo F. McLaughlin, John P. Main, Angus J. Nicholson, Ray F. Shumaker, and Roy J. Tibbets.

The largest group was from the states of Kansas and Oklahoma. At Tulsa, 37 employees were honored, as follows: Walter F. Polston, Independence, Kansas; John A. McGrew, Howard, Kansas; Everett Lingle, Caney, Kansas; Carl J. Smith, Winfield, Kansas; Carl E. Swank, Caney; John A. Glynn, Independence; George W. Jones, Independence; Newton A. Banks, Sedan, Kansas; Donald R. Sternburg, Caney; Claude C. Riley, Virgil, Kansas; Chester A. Frisinger, Independence; John E. McQuain, Independence; Harry M. Whitman, Peru, Kansas; Bernard J. Slattery, Caney; Ernest W. Rowe, Tulsa, Oklahoma; Lyman H. Latimer, Nowata, Oklahoma; George R. Cary, Nowata; Carl C. Kaufman, Jenks, Oklahoma; Charles B. Corley, Turley, Oklahoma; Joseph A. Fournier, Bartlesville, Oklahoma; Roy W. Monfore, Jenks; Charles D. Gilbert, Pharoah, Oklahoma; John E. Flynn, Bristow, Oklahoma; Leo W. Carroll, Nowata; John R. Beeson, Bartlesville; Vern C. Campbell, Drumright, Oklahoma; Benjamin F. Killion, Blackwell, Oklahoma; William A. O'Hara, Cushing, Oklahoma; George W. Murphy, Blackwell; David R. Robinson, Bristow; Kay Jackson, Garber, Oklahoma; Chris K. Ericksen, Jr., Pawhuska, Oklahoma; John W. Houchin, Okmulgee, Oklahoma; Charles H. Whitmore, Oklahoma City, Oklahoma; Howard E. Coleman, Wewoka, Oklahoma; William L. Carter, Drumright, Oklahoma, and Laurent B. Smith, Bristow.

At Fort Worth, Texas, recipients of the awards were Richard G. Doyle, Joinerville, Texas; Walter I. Clark, Fort Worth; Elmer E. Peters, Mexia; Joseph Nance, Wichita Falls, and Leo B. Smith, Wichita Falls.

For each of the areas, the employee with the longest continuous service was duly recognized and presented with a special award consisting of a Hamilton wrist watch engraved with his name and record. The men receiving these awards were Donn J. Chalfant, Ray F. Shumaker, Ernest W. Rowe, and Walter I. Clark.

Below, dinner in Fort Worth, one of four Sinclair held in honor of 35-year men.



This Costs Money, Too

...and it doesn't make you any friends!

Pipe for utility distribution systems deserves even better protection than pipe for pipelines. For one thing, it costs more to dig up when something goes wrong. Also those noisy pavement-breakers and traffic-snarling holes in the streets don't do your public relations any good.

Sure, factory coated pipe costs a shade more, but it pays off by staying in the ground longer and saving on maintenance expense.

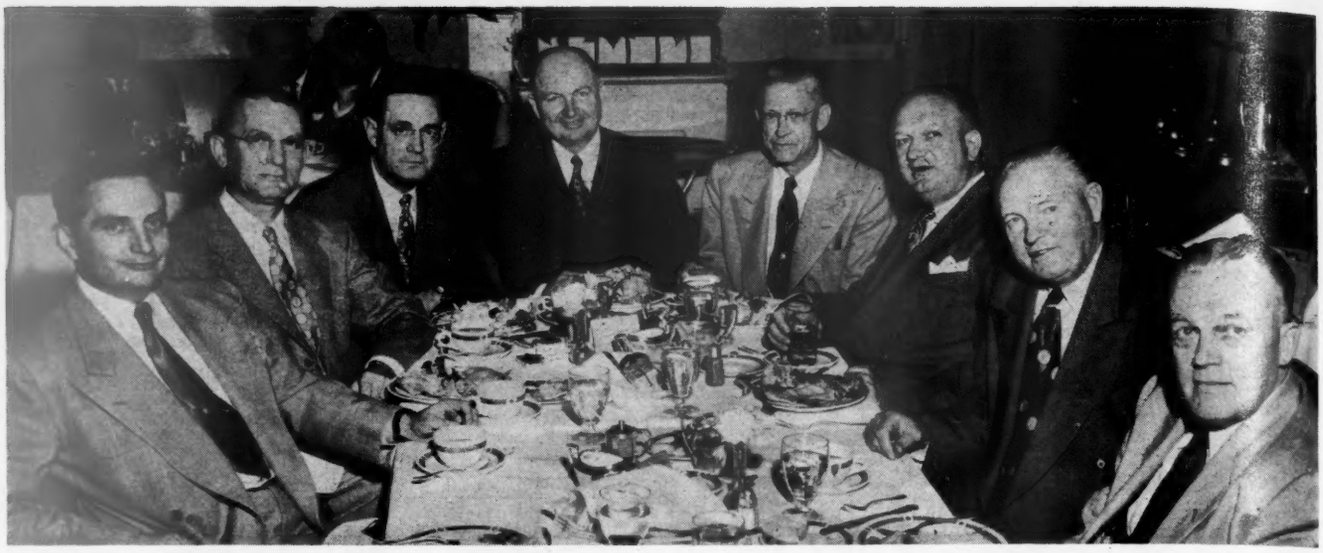
P.S. To our pipe coating plants at Girard and Lorain, Ohio, we have added a third at Hammond, Indiana—centered in the steel pipe mill section of the Chicago Switching District. This location enables our customers in the west and southwest to take advantage of the Hill, Hubbell process with faster deliveries. Minimum freight rates include the privilege of coating and wrapping pipe in transit. The new plant has ample storage space.

Hill, Hubbell and Company

Division of GENERAL PAINT CORPORATION

Headquarters: 3091 Mayfield Road, Cleveland 18, Ohio

Leaders in Pipe Protection for a Quarter Century



Pipeliner M. C. Alcorn Honored. M. C. Alcorn, assistant pipe line manager for Shell Oil Company, was recently honored on his 25th anniversary with the company at a Town House luncheon attended by LeMoyne Porter, above left, A. C. Wright, F. O. McKeany, Alcorn, W. C. Roberts, F. R. Schmieder, R. S. Tulin and C. A. Peterson, a group that averages more than 27 years of service with Shell. Alcorn started with Shell in 1926 in the survey department of the Los Angeles pipe line office. He became district superintendent of Shell's southern division pipe line in 1938, and assistant pipe line manager in 1946.

September Completion For Jud-Bowie Line

Temperatures of 114 to 116 degrees have slowed the progress of two pipe line construction crews on the Service Pipe Line Company's 135-mile Jud-Bowie line, Division Manager F. M. Willenburg says.

Welders, compelled to wear heavy clothing and hoods to protect themselves from sparks, have been made ill by the heat, Willenburg said. The Smith Construction Corporation, building the line from the Brazos River west to Jud in northwestern Haskell county, lost a full day because of the sick welders.

Working approximately 110 men on the construction job, Smith's line headquarters are in Throckmorton.

A pipe reconditioning yard at Haskell, employing about 35 men, is cleaning, repairing, and straightening 33.5 10-in. pipe that was taken up in Missouri, Illinois, and East Texas.

The O. R. Burden Construction Company is laying pipe east from the Brazos River. This segment of the line will be constructed through the eastern part of Throckmorton County and through Young, Archer, and Clay counties to Bowie in Montague County. Approximately 112 men are employed and line headquarters are in Henrietta.

A pipe reconditioning yard also is operating in Henrietta, employing about 30 men. A total of 36.5 miles of pipe will be cleaned and reconditioned.

At Olney and Hajek, 57 miles of 10-in. pipe taken up in Nebraska have been unloaded. This is being strung along the right-of-way by two stringing carriers, J. L. Cox and Son, from the Brazos River east, and Parkhill Trucking Company from the river west.

When the job is completed, about the middle of September, the new line will provide an outlet for increasing oil production in Stonewall, Haskell, and Knox counties, Willenburg said. Gathering systems will connect production in the Old Glory, Kiowa Peak, and North Aspermont, South Haskell, and North Knox City fields.

Gas Company Operating Revenues and Income

Operating revenues of natural gas companies reporting to the Federal Power Commission totaled $116,687,051 in May, 1951, an increase of 23.1 per cent over the $94,813,500 reported for the same month a year ago.

Gas utility operating income for May, 1951, amounted to $18,387,652, up 0.6 per cent from the $18,280,072 reported for May, 1950. Net income for the month was $13,977,398 compared to $15,450,383 reported in May, 1950.

Gas operating revenue deductions amounted to $98,410,137, an increase of 28.5 per cent. Of this total, operating expenses accounted for $72,300,147, up 30.3 per cent; depreciation for $9,696,357, up 18.1 per cent; and taxes for $16,413,633, up 27.2 per cent.

Gas sales to ultimate consumers in May, 1951, were 180,802,000,000 cu ft, an increase of 12.7 per cent over May, 1950. Sales to residential consumers increased 3 per cent and to commercial and industrial consumers 3.8 per cent and 15.9 per cent, respectively. Revenues from sales to ultimate consumers increased 11.5 per cent and amounted to $57,859,572. Revenues from the three classes of service—residential, commercial and industrial — increased 3.4 per cent, 3.3 per cent, and 23.2 per cent, respectively.

For the 12 months ended May 31, 1951, gas operating revenues aggregated $1,434,816,006, an increase of 25.1 per cent over the total of $1,146,922,750 reported for the 12 months ended May 31, 1950. Net income for the period amounted to $185,170,871 compared to $162,527,421 for the previous 12 months.

Net gas utility plant of the reporting companies aggregated $3,347,153,702 on May 31, 1951, compared to the $2,789,197,612 reported a year earlier.

Herb Fisher, Director

A. S. Crutcher

Gene Rolfs

Jim Cummings

Announcing

the formation of

C R C

ENGINEERING COMPANY

A new organization to provide complete engineering design services for crude, gas and products pipe lines, including economic studies of proposed projects.

With experience records in engineering design and construction of pipe lines for more than twenty years, the principals in C-R-C Engineering Company have contributed to the design and construction of many of the major pipe line systems now in operation.

The partners in this joint venture are H. E. (Herb) Fisher, A. S. Crutcher, Gene Rolfs and Jim Cummings. Fisher has been associated with the engineering design and construction of pipe lines for 20 years and recently resigned as Chief Engineer of the Standard Oil Co. (Ind.) Pipe Line Department. The other members of the new firm . . . Crutcher, Rolfs and Cummings . . . have been leaders for nearly twenty years in developing, manufacturing and supplying the pipe line industry with the principle work equipment now in use throughout the world.

CONSULT US ON YOUR PIPE LINE PROBLEMS. OUR EXPERIENCE AND "KNOW-HOW" GUARANTEES A THOROUGHLY ENGINEERED PIPE LINE SYSTEM WHICH WILL OPERATE AT MINIMUM COST.

C·R·C ENGINEERING COMPANY

COMPLETE ENGINEERING DESIGN SERVICES

Crude — Gas — Products

Pipe Lines

7825 Katy Road, Phone VIctor 6391, Houston, Texas

To obtain more information on products advertised see page E-43

Directors Trans-Northern Pipe Line Announced

A. N. Horne, president of The Trans-Northern Pipe Line Company, Ltd., Toronto, Canada, has the names of the directors of the newly formed company. Jointly owned by the Shell Oil Company of Canada, Ltd., McColl-Frontenac Oil Company, Ltd., and The British American Oil Company, Ltd., Trans-Northern will transport finished petroleum products from Montreal East to Ottawa, Toronto, and Hamilton.

The directors are: W. M. V. Ash, Toronto, and R. P. Ritchie, Toronto, representing Shell; T. C. Twyman, Montreal, and A. G. Farquharson, Montreal, representing McColl-Frontenac; and Robert E. Kepke, Toronto, and John R. Dawson, Toronto, representing British American. Horne also announced that H. H. Bronsdon, formerly secretary-treasurer of B-A, has been appointed secretary-treasurer of Trans-Northern.

Texas Eastern Lets River Crossing Contracts

Texas Eastern Transmission Corporation has awarded to Pentzien, Inc., Omaha, Nebraska, a contract for the construction of 30-in. pipe line under the Cumberland and Kentucky rivers.

Oklahoma Contracting Company, Inc., Dallas, Texas, has been awarded a contract for construction of the 30-in. pipe line under the Tennessee River.

TO REPAIR PIPE LEAKS—
QUICKLY, PERMANENTLY

ANY PRESSURE — ANY TEMPERATURE

SKINNER-SEAL EMERGENCY PIPE CLAMP for pinhole or corrosion leaks.

SKINNER-SEAL PIPE LINE CLAMP for long splits and bad corrosion leaks.

In stock—all supply stores

M. B. SKINNER COMPANY
SOUTH BEND 21, INDIANA, U. S. A.

Gas Industry Conference to Be Held in Kansas City

Preparation against attack and sabotage is one of the dramatic subjects to be discussed at the second annual safety conference sponsored by the Accident Prevention Committee of the American Gas Association at the Hotel Phillips, Kansas City, Missouri, on September 17 and 18. Human relations in accident prevention, new methods of resuscitation, and safe practices in gas production also are timely and pertinent subjects on the two-day program that will be of vital interest to all gas industry safety executives.

W. H. Adams, safety director, The Manufacturers Light and Heat Company, Pittsburgh, and chairman of the AGA Accident Prevention Committee, will preside at the conference. Delegates will be welcomed at the opening session by B. C. Adams, president, The Gas Service Company, Kansas City.

Dr. A. E. Neyhart, Pennsylvania State College, will speak on the subject of safe driving at the morning session, Monday, September 17. Dwight Sargent, personnel director, Consolidated Edison Company of New York, will discuss the human relations aspects of accident prevention from a background of experience with one of the largest public utility companies in the world.

E. A. Koenig, general superintendent, Texas Eastern Transmission Corporation, will talk on compressor station safety at the afternoon session on Monday. With the rapid growth of natural gas transmission lines into manufactured and mixed gas areas, safety in compressor stations becomes more important in the public eye. Precautionary measures in drilling and in tapping lines under pressure are additional subjects listed on the program for Monday.

Safe practices to be followed in the production of water gas and coal gas will be discussed on Tuesday morning. William J. Alexander, Public Service Electric and Gas Company, Newark, New Jersey, and Walter J. Deveney, The Peoples Gas Light and Coke Company, Chicago, are scheduled to head these discussions. Safe measures in hunting for gas leaks and safe practices in handling materials, are marked for discussion at that session.

E. S. Beaumont, The Peoples Gas Light and Coke Company, Chicago, chairman of the program committee for the conference, will preside at a luncheon meeting on Tuesday. D. A. Hulcy, president of AGA will present awards for outstanding gas industry safety performances at the luncheon meeting. Hulcy, who is also president of Lone Star Gas Company, Dallas, Texas, and president of the United States Chamber of Commerce, is actively interested in accident prevention. Improvement of gas industry accident prevention records is one of the primary objectives to be achieved during his term in office as president of AGA.

"Be Prepared for Sabotage or Attack" is the opening subject of the afternoon program on Tuesday. Lt. Colonel Frank E. Costanzo of Pittsburgh, has been selected to talk on this all-important subject. As a member of the Ordnance Department of the Organized Reserve Corps, Colonel Costanzo is presently assigned to 2201-Research and Development Group, and is well acquainted with subversive and undercover tactics used by enemy fifth columns. It is known public utility plants are primary targets of subversive forces, and this talk should be especially pertinent and valuable.

J. E. Carnehan, The Peoples Gas, Light and Coke Company, Chicago, will present some of the latest methods of resuscitation and his talk will be followed by showings of movie films and sound-slide presentations available for use as visual aids in improving accident prevention records of gas utilities.

A luncheon and tour for the ladies has been arranged through the courtesy of The Gas Service Company and the local safety organizations of Kansas City. The Mines Safety Appliance Company will act as hosts to the delegates at a social hour on Monday evening.

Increased System Capacity For Great Lakes Line

Completion of an 8-in. pipe line between Des Moines and Iowa City, Iowa, by Great Lakes Pipe Line Company and operation of the company's 12-in. line from Barnsdall, Oklahoma, to Des Moines on approximately 50-mile station spacing have been announced by Harry Moreland, company president.

These steps provide increased system capacity for supplying the Iowa City and Chicago delivery terminals of the company. Gasoline consigned to Iowa City is now being pumped through the new 106-mile line from Des Moines, permitting the 6-in. line from Des Moines to Chicago to be used exclusively for supplying Chicago.

Capacity of the 6-in. line has been increased by placing the entire line on 50-mile operation by reactivation of existing stations at Lee and Prophetstown, Illinois, east of Iowa City. Prior to construction of the 8-in. section to Iowa City, the smaller line was used to supply both Iowa City and Chicago.

Capacity into Des Moines was increased when newly installed pumping units at existing stations at Independence and Paola, Kansas; Osborn, Missouri, and Osceola, Iowa, were put into operation recently on the 12-in. line from Barnsdall. As the station at Kansas City is still idle because of flood damage to equipment, present pumping is being done by bypassing Kansas City from Paola on the south to Paradise, Missouri, 25-miles north of Kansas City, where two units powered by converted Allison aircraft engines have been connected temporarily.

Four tanks formerly at the Osceola station are being re-erected at the Chicago terminal. Additional tankage for Iowa City is on order and the tanks will be erected as soon as delivery is made.

FPC Dismisses Requests Of New England Companies

The Federal Power Commission has dismissed applications of Blackstone Valley Gas and Electric Company, of Pawtucket, Rhode Island, and Fall River Gas Works Company, of Fall River, Massachusetts, which were seeking FPC orders directing Northeastern Gas Transmission Company, of Springfield, Massachusetts, to supply them with natural gas.

Blackstone and Fall River are among the companies which Algonquin Gas Transmission Company, of Boston, Massachusetts, has been authorized to serve. The New England natural gas market was divided by the FPC in orders issued last fall and winter, with Northeastern authorized to serve certain markets in Massachusetts, Connecticut, and New Hampshire, and Algonquin authorized to serve certain Connecticut, Massachusetts, and Rhode Island markets.

In its orders dismissing the Blackstone and Fall River applications, the commission said that its February order authorizing Algonquin to serve the two companies was issued after consideration of a record in which Fall River and Blackstone requested the FPC to authorize Northeastern to serve them, rather than Algonquin. The record showed that unnecessary duplication of facilities would have resulted if Northeastern had been authorized to serve Blackstone and Fall River, the FPC said.

Independent Natural Gas Assn. to Meet September 24

The Independent Natural Gas Association of America will hold its annual membership meeting at the Skirvin Hotel in Oklahoma City, Oklahoma, September 24.

Speakers are:

Hon. Johnston Murray, governor of Oklahoma.

Dr. F. C. Hockema, vice president and executive dean, Purdue University.

C. P. Rather, assistant deputy administrator, Petroleum Administration for Defense.

The following participating in a round-table discussion on natural gas storage problems: Scott Hughes, Southern Union Gas Company; I. I. Gardescu, Transcontinental Gas Pipe Line Corporation; John Gere, Cities Service Gas Company, and J. J. Hedrick, Texas Illinois Natural Gas Pipe Line Company.

Hon. Robert S. Kerr, U. S. Senator from Oklahoma, will be the guest speaker at the dinner, at which the hosts will be Cities Service Gas Company, Phillips Petroleum Company, Oklahoma Natural Gas Company, and Consolidated Gas Utilities Corporation.

At the business luncheon, President Paul Kayser will make his report and there will be an election of directors.

The program also will include the showing of an A. O. Smith Company motion picture concerning pipe manufacturing operations.

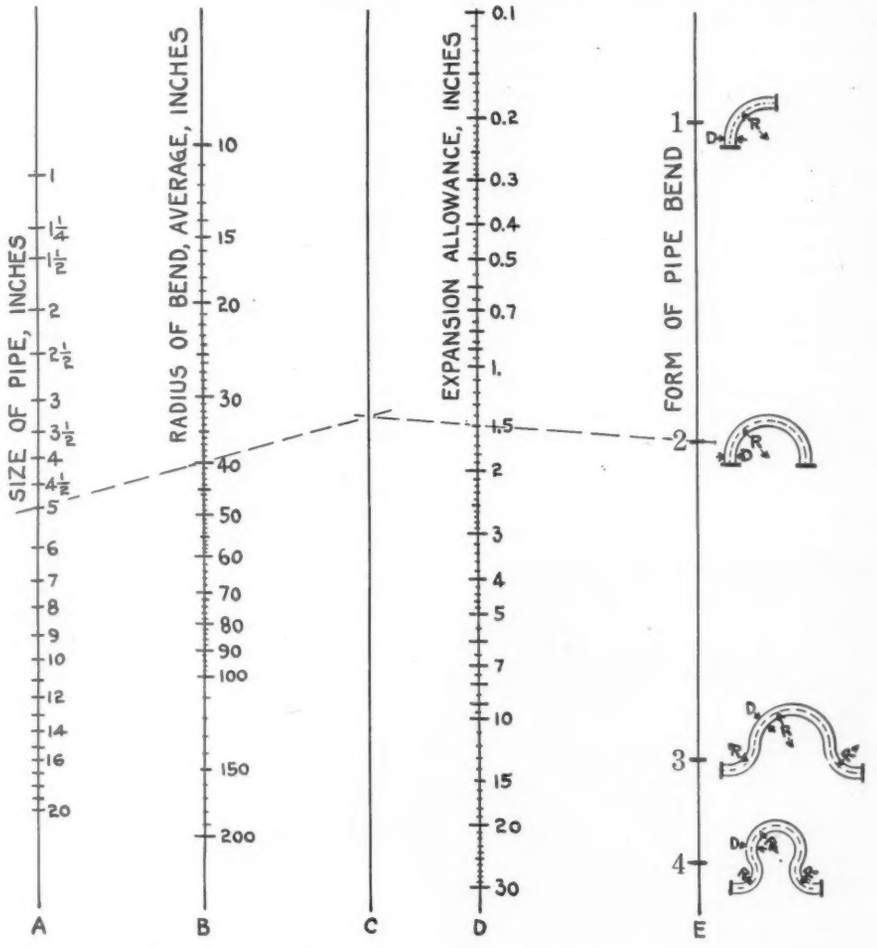
PIPE BENDING CHART

W. F. SCHAPHORST

The accompanying chart will be found useful for determining the average radius of bend that should be given to common forms of pipe bends, numbers 1, 2, 3, and 4, as shown at the right, column E.

Also, knowing the radius of bend, the size of pipe, and the form of bend, column D gives the expansion allowance of that bend.

For example a 5-in. pipe was bent to a radius of 40 in., the bend being a common U-bend as shown by No. 2 in column E. What expansion may be allowed?



The dotted line drawn across the chart shows how the chart is used. Run a straight line through the 5 column A and the 40 column B and locate the intersection with column C. Then from that point of intersection run over to the mark in column E opposite the figure 2 and the intersection through column D gives the answer as 1.5-in. expansion allowance.

If the size of the pipe were the same, 5 in., the average radius 40 in. and the bend were a No. 4 bend, the expansion allowance would be 3.7 in. If the bend were a No. 1 bend the expansion allowance would be 0.75 in.

Similarly, if the expansion allowance is already known, if the form of bend is known, and if the size of pipe is known, the average radius to which the bend should be made may be determined. In other words, knowing any three of the four factors given in Columns A, B, D, and E the fourth or unknown factor is easily determined by following the method as explained above.

The chart is based upon the following rules;

For Bend No. 1—Square the average radius of bend in inches and multiply by 0.0026 and then divide by the outside diameter of the pipe in inches.

Bend No. 2—Same as No. 1 but use 0.0052.

Bend No. 3—Same as No. 1 but use 0.0104.

Bend No. 4—Same as No. 1 but use 0.013.

In the chart these operations are already performed — the radii are squared, exact outside pipe diameters are employed, and the proper factors are used. * * *

Microwave System For Texas Illinois Gas Line

Motorola, Inc., of Chicago started construction on another of the largest multi-channel microwave relay systems ever built when it began work on the 1000-mile network for the Texas Illinois Natural Gas Pipeline Company. The system, scheduled for completion in October of this year, employs carrier frequencies in the 6575-6875 megacycle range.

Included in the double-FM sub-carrier multiplex system will be 40 terminal and repeater stations. The line runs north from the terminal at Hungerford, Texas, to Texarkana, to Malvern, Arkansas, to Marble Hill, Missouri, to Hoffman, Illinois, and to Chicago. A microwave relay stub connects the Houston office to the main line at North Houston.

Circuits will be used for private telephone lines, party lines, and for a VHF mobile radio relay and control system.

Repeater station housings along the line are of a new concrete-block construction and are designed so that paraboloid antennas for sending and receiving are mounted on the roof, and all other electronic equipment is incorporated within them. The unique Motorola system makes it possible to service all equipment at ground level as a result of the design of reflecting signals from 45-deg flat passive reflectors mounted at the top of the towers.

This map shows the route of the Motorola microwave relay system now being constructed for the Texas-Illinois Natural Gas Pipeline Company.

An extremely high level of circuit reliability under all operating conditions will make maintenance of the communications system by the natural gas company an economical and practical undertaking. Complete automatic switchover standby equipment, including separate cabinets and power supplies, are built into the system. Sensing circuits can recognize a failure in any tube or component and automatically switch to standby equipment, thus making almost uninterruptable communications possible.

The VHF F.M. 2-way radio system for mobile communications joins the Natural Gas Pipeline Company VHF system at the Joilet, Illinois, meter station.

Motorola has constructed or contracted to build 18 microwave relay systems to date. One of the largest, the 1000-mile Mid-Valley Pipeline Company system, has been in operation since the beginning of the year.

Gulf Oil Building 18,000-Ton Tanker

A new 18-000-ton tanker for coastwise service has been ordered by Gulf Oil Corporation, Willard F. Jones, vice president, Marine Department, announces.

"The new Gulf tanker," said Jones, "will be 551 ft long, with a beam of 68 ft and a depth of 37 ft, 6 in. It will have a deadweight approximating 18,000 tons, and 7000 shaft hp.

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CLEVELANDS longer work life, as proved by the many contractors who still have early-model CLEVELANDS in daily use, cuts overhead and replacement costs on your heavy equipment. CLEVELANDS famous ruggedness and dependability under the roughest digging conditions save on maintenance expense, cut down-time for repairs that can tie up your whole spread.

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See your local distributor today for the full facts and figures on dependable CLEVELAND performance tailored to pipeline industry requirements. The Cleveland Trencher Company, 20100 St. Clair Avenue, Cleveland 17, Ohio.

Date for Hearing On Gas Imports Is Set

The Federal Power Commission will hold a hearing beginning September 10, 1951, in Billings, Montana, on the application of the Montana Power Company, of Butte, Montana, for authority to import natural gas from fields in Alberta, Canada, into Montana.

The hearing was originally set for August 20 in Washington, D. C. On August 2 the National Coal Association, United Mine Workers of America, and the Railway Labor Executives Association, interveners in the proceeding, requested that the hearing be postponed to a date not earlier than September 15, and be set at a place in the state of Montana that the commission deems best suited to the convenience of all parties concerned.

Many local coal and railroad interests in Montana, Wyoming, and in Utah also informally urged that the Federal Power Commission grant request of the interveners.

The commission therefore ordered that the public hearing previously set for August 20 in Washington be postponed to begin on September 10, at 10:00 a.m. at Billings, Montana.

The Montana Power Company is proposing to import the gas from fields in the Pakowki Lake area in southeastern Alberta. Two newly-formed subsidiaries of Montana Power would produce and transmit the gas in Canada. The facilities to be used include about 18 miles of 16-in. line extending from the Pakowki Lake area to a point on the Canadian-Montana border, and approximately 52 miles of 16-in. line extending from that point to a connection with Montana Power's existing system near Cut Bank, Montana. The 18 miles of line would be owned and operated by one of the new subsidiaries of Montana Power.

Great Lakes Terminal Back in Operation

Motor transport and railroad tank car loading was resumed August 20 from the Kansas City, Kansas, delivery terminal of the Great Lakes Pipe Line Company. The terminal had been closed since July 13 because of flood damage to equipment.

Full capacity for loading both transports and tank cars were available when terminal operations were resumed, Harry Moreland, company president, said. The embargo on shipments consigned to Kansas City, which has been in effect since the terminal was closed, also was lifted.

Great Lakes operates as a common carrier pipe line company, moving products from Oklahoma and Kansas refineries to 15 terminals in seven midwest and north central states. All terminals except Kansas City have remained in continuous operation.

Joseph Racker

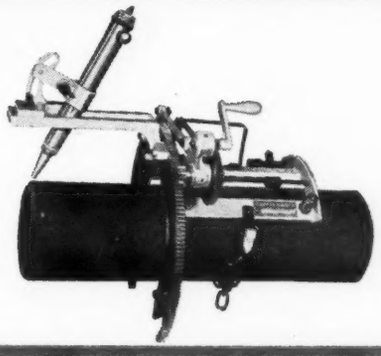
Joseph Racker Company Microwave Consultants

The Joseph Racker Company, a firm of microwave consultants, has been organized with offices at 67 West 44th Street, New York 18, New York, to provide a complete microwave communications service for the pipe line industry, including planning, installation, and maintenance.

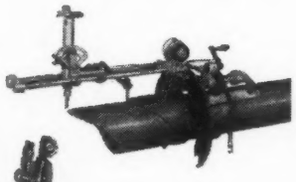
Joseph Racker, co-author of the text "Pulse Techniques" and author of "Fundamentals of Microwave Communications," has had wide experience in the field, including more than six years with the International Telephone and Telegraph Corporation, with headquarters at 67 Broad Street, New York City 4, New York.

for SPEED and ECONOMY use . . .

H&M PIPE CUTTING and BEVELING MACHINE



ATTACHMENTS



Shape Cutting Attachment for cutting the various shapes of pipe intersections.

Out-of-Round Attachment is used when pipe is out of round.

speed . . . . . Split horseshoe shaped gear permits machine to slip quickly over pipe. Fast operating snap chain fasteners hold it in place. A complete cut and bevel can be made in a 12 inch pipe in about two minutes.

economy . . . You'll soon save several times the cost of the machine in labor, gas and transportation charges. H&M takes approximately one-half the labor and gas to make the cut as hand cutting and the work is all done in the field.

portability . . Bring this light (24 to 155 pounds) but durable machine to the pipe instead of moving the heavy pipe to the machine. Remember, H&M designs for SPEED and ECONOMY.

Let us arrange a demonstration to show you how H&M will save you money and time. Or write for further details . . .

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PIPELINE PERSONALS

Claude L. Draper recently took the oath of office for his sixth term as a member of the Federal Power Commission. His new term expires June 22, 1956. Commissioner Draper has been a member of FPC since 1930 and in point of service is the oldest member of the commission.

E. G. (Gene) Baker, Tulsa Oklahoma Service Pipe Line Company supervisor, has been named assistant chief of the transportation materials branch of the Petroleum Administration for Defense. Baker has been supervisor of the wage and salary section of the company's industrial relations department since 1945. It is the second time Baker has served the federal government in an emergency petroleum agency. He was an expeditor of materials for construction of oil pipe lines in World War II.

Baker attended Ohio University and Randolph College at Cisco, Texas, working between semesters as a roustabout in Texas and Oklahoma oil fields. After receiving a degree in business administration at Randolph, he became a tool dresser and driller. He joined Service Pipe Line at Seminole in 1934.

Jeff L. Hamilton has been made compressor station superintendent of Division I for Transcontinental Gas Pipe Line Corporation, and will have his headquarters in Eunice, Louisiana. Hamilton has been division superintendent at Tyler, Texas, for the Lone Star Gas Company.

Robert A. Hornby, executive vice president of Pacific Lighting Gas Supply Company, Los Angeles, has announced a number of elections and appointments.

Marion L. Fort, formerly vice president and general superintendent is now vice president and general manager. Fort has been connected with Pacific Lighting Gas Supply Company or its predecessor companies since 1923 and has been the principal operating officer since its formation. **R. W. Todd,** formerly chief engineer, was elected a vice president and retains the post of chief engineer. Todd began work with the predecessor of Pacific Lighting Gas Supply Company in 1936, and has served in the capacity of chief engineer since 1945. **R. C. Loomis** is now superintendent of operations; **J. Van Paddenburg** is promoted from chief accountant to auditor; and **T. Hume West** has been named land and right-of-way representative.

Parker S. Wise has been appointed to the newly created position of assistant general manager of the Marine Transportation Department, Socony-Vacuum Oil Company, Inc., 26 Broadway, New York. Wise was assistant manager in the traffic division of the Marine Transportation Department. He will be succeeded in this position by **Herbert A. Steyn, Jr.,** supervisor of foreign deep-sea fleet traffic.

George A. Limb, Wewoka, Oklahoma, district electrician for the Interstate Oil Pipe Line Company, has accepted a position as district electrical superintendent with Esso-Colombiana S.A. at El Centro, Colombia, South America. In his new position Limb will supervise the departmental office, steam electrical power plant, electrical repair shop, telephone and radio communications, maintenance of electrical lines, motors, etc.

Cecil Van Gundy has been promoted to superintendent of gas control in the transmission department of Panhandle Eastern Pipe Line Company, having his headquarters in Kansas City. **Robert S. Heusel,** assistant measurement engineer, succeeds Van Gundy as measurement engineer in the gas measurement department.

J. R. Wait, Jr., was recently made chief engineer of the Houston Pipe Line Company with headquarters in Houston, Texas. He has been, for the last year and a half, chief engineer for Fish Pipe Line Construction Corporation on the Texas Illinois Natural Gas Pipeline Company project. Wait is a graduate of Clemson A. and M. College of South Carolina and for 19 years has been connected with the pipe line industry, except for a period of 3½ years during World War II when he was an officer in the U. S. Navy. He was first employed by the United Gas Pipe Line Company in construction and engineering capacities. Next he became superintendent of construction for J. S. Abercrombie Oil Company. When Texas Eastern Transmission Corporation purchased the "Inch" lines, he was made superintendent of construction and special assistant to the chief engineer. Later he became chief engineer of the affiliated companies, Pan American Production Company, and the Pan American Gas Company. He joined Fish Pipe Line Construction Corporation in April, 1950.

At Houston Pipe Line he takes over the post formerly occupied by **F. Y. Hutchinson,** who becomes staff consultant. **M. T. Duddleston** is the new chief engineer at Fish Pipe Line.

George D. Cross, formerly maintenance mechanic at Haven, Kansas, for Panhandle Eastern Pipe Line Company, has been transferred to Louisburg as assistant chief engineer. He takes the place of **Kenneth Hamilton** who is now with Trunkline Gas Company. **Joseph R. Shaw,** engineer at Zionsville, Indiana, recently was made assistant chief engineer at the Pleasant Hill station, filling a vacancy created when **F. J. Thielen** went with Trunkline.

M. O. Johnson has been made assistant manager of the supply and transportation department of Phillips Petroleum Company, according to a joint announcement by **K. S. Adams,** chairman, and **Paul Endacott,** president. **J. L. Kyser** succeeds Johnson as coordinator, with **H. J. Horsch** assistant.

Johnson also has been elected executive vice president of Phillips Pipe Line Company, a wholly owned subsidiary of Phillips Petroleum Company. In other organizational changes of Phillips Pipe Line Company, **J. W. Boyd** became vice president in charge of operations of the products pipe line division and **W. H. Wallace** vice president in charge of the crude oil pipe line division.

Williams F. Naeher recently joined the staff of Transcontinental Gas Pipe Line Corporation as supervisor of methods and procedures. He will make his headquarters in Houston, Texas, and will prepare and keep up to date all company procedures, both in the office and in field operations. He has been with Arthur Anderson and Company in Houston.

J. W. "Jack" Hawkins, engineer at Tulsa, Oklahoma, for Service Pipe Line Company, has been promoted to planning engineer. Hawkins received a bachelor of science degree in business and engineering administration from Massachusetts Institute of Technology in 1948. He joined Service in July of that year as a junior engineer and was promoted to engineer February 1, 1951.

M. M. Bowen, with Colombian Petroleum Company at Cucuta, Colombia, has been visiting in the United States. Bowen, an electrical engineer, is in charge of corrosion protection for the company's 351 miles of 12-in. pipe line, as well as other installations.

George Holt has been made district clerk of District 10 by Transcontinental Gas Pipe Line Corporation, and has his headquarters at Linden, New Jersey. During World War II Holt was a parachute Infantryman with the 11th Airborne Division of the U. S. Army and served 13 months overseas.

Wayne A. Johnson, who has been a field corrosion engineer with the Texas Pipe Line Company, Houston, Texas, is now senior corrosion engineer for Cathodic Protection Service, Houston, Texas. He is a 1947 graduate of A. & I. College.

NEWS

Texas Eastern Work Moving Along Fast

Texas Eastern Transmission Corporation, Shreveport, Louisiana, reports that construction is underway on seven out of ten sections of its new 30-in., 791-mile pipe line from Kosciusko, Mississippi, to Connellsville, Pennsylvania. Work has started on three compressor stations and construction of additional stations is scheduled to begin immediately, the company said.

Completed in August was a 35-mile pipe line to the Oakford storage field in Pennsylvania. Texas Eastern has been delivering gas to Oakford through the facilities of another company since April 10 at the rate of approximately 35,000,000 cu ft per day.

Texas Eastern's current expansion program will cost approximately $114,300,000 and increase the company's delivery capacity to about 1,200,000,000 cu ft of natural gas a day.

Atlantic's New Marine Terminal in Operation

One of the most modern and finest equipped marine terminals in the country has been completed by The Atlantic Refining Company on Chelsea Creek, Revere, in the greater Boston area. It will be operated the year around to facilitate the supply of products to Atlantic dealers and distributors within a 100-mile radius of Boston.

State and city officials were among the hundreds of guests who attended the open house and dedication ceremony at the terminal to celebrate the completion of the big plant, which covers approximately 30 acres.

A feature of the ceremony was the presentation of the keys to the terminal to Cal F. Favorite, Boston manager of the company, by Dr. Lester M. Goldsmith, general manager of Atlantic Refining's engineering and construction department.

The Revere Terminal was under construction for more than two years. In addition to four storage tanks, loading racks and other facilities, there are six buildings at the terminal — an office building, an oil storage tank building, a warehouse, a garage, a transformer vault, and a foam house that contains the finest type of fire fighting equipment.

At high tide there is enough water in Chelsea Creek to bring in ocean-going tankers, most of which will come from Atlantic's refinery at Atreco, Texas. Facilities make possible an average discharge rate of 12,000 bbl per hour, thus enabling the tankers to unload their cargoes in approximately 10 or 12 hours.

Twelve separate loading racks are situated on the Lee Burbank Highway, which runs through the terminal grounds. Each rack is equipped with fast-flow printing meters and loading arms with sliding tubes. These arms enable the operator to load all compartments without moving the truck. With products being supplied to these racks by four 1500-gal-per-min electrically driven pumps, the average truck loading time is less than 15 minutes.

On the tank farm at the terminal there are now four 3,400,000 gal storage tanks. Two of these are cone roof tanks in furnace oil service, and two are floating roof tanks in gasoline service. Work is now under way to prepare sites for two additional cone roof tanks of similar capacity, which will be put into furnace oil service when they are completed, the company reports.

Pipe Linings Move To New Address

Pipe Linings, Inc., a subsidiary of the American Pipe and Construction Company, has moved to a new home at 4675 Firestone Boulevard, South Gate, California.

Pipe Linings, Inc., is licensed under the Tate Process to recondition pipe lines in place in sizes 4 in. to 16 in. inclusive, and with the Centriline Division of the American Pipe and Construction Company is licensed to recondition pipe in sizes 16 in. up by the Centriline Process.

The president of Pipe Linings, Inc., is Wm. A. Johnson.

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CINCH outside line-up clamps apply even all around pressure to pipe ends

Pressure applied through swivel handled hydraulic jack equalizes the high and low of pipe ends, bringing them into perfect roundness for welding.

A 1951 model piece of equipment for tie-in, setting valves and fittings on your pipeline or compressor stations.

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PIPE LINE PROJECTS

PAD Approves Service Pipe Line Expansion

The Petroleum Administration for Defense has approved Service Pipe Line Company's plans for oil pipe line facilities to serve added refinery capacity now under construction in Kansas and Missouri.

Pipe lines to be laid will loop part of the company's existing multi-line system between Drumright, Oklahoma, and Freeman, Missouri. The approved projects consist of 29 miles of 20-in.; 19 miles of 16-in.; two miles of 12-in.; installation of a 167,000-bbl tank, and miscellaneous changes in manifolds and pump station units.

Fifteen miles of the 20-in. will be laid north from the company's Drumright pump station, and 14 miles north from Blake station, Oklahoma. The 19 miles of 16-in. will be laid from south of Kansas City to Sugar Creek, Missouri. The 12-in. will be laid to Neodesha, Kansas, from the company's main line system. The tank will be installed at Drumright, Oklahoma.

Texas Gas Receives Temporary Authorization

The Federal Power Commission has granted Texas Gas Transmission Corporation, of Owensboro, Kentucky, temporary authorization for construction of its "South Louisiana Supply Lateral," provided such facilities shall be used for service only to the company's existing customers that it has been authorized to serve under previous orders of the commission.

The company's proposed "South Louisiana Supply Lateral," for which it now gets temporary authorization, will consist of 189 miles of 26-in. pipe line together with auxiliary facilities estimated to cost a total of approximately $12,500,000. The line would extend from Acadia Parish to a connection with the company's existing facilities in Morehouse Parish, Louisiana.

In view of the magnitude and complexity of the proceedings in the applications of Texas Gas Transmission Corporation (Docket Nos. G-1570, G-1578 and G-1657, Louisville Gas and Electric Company (G-1672) and United Gas Pipe Line Company (G-1681) the commission denied the motions by counsel for Texas Gas Transmission and United to omit the intermediate decision procedure and forthwith render its final decision and also denied its motion that all parties be directed to file briefs simultaneously within two weeks after the close of the hearings without the right of any party to file a reply brief.

The hearings in these consolidated proceedings began on May 28, 1951, and have progressed continuously to date with the exception of two short recesses, the commission points out in its order. The transcript of record covers nearly 7000 pages and 250 exhibits. In addition, hundreds of pages of transcript and numerous exhibits from other proceedings have been incorporated in this record by reference.

Ventura-Fillmore, California Oil Line Announced

The Texas Company, through Torrey H. Webb, vice president at Los Angeles, California, has announced its intention to install approximately 30 miles of 8-in. pipe line between the Ventura Avenue oil field, Ventura, California, and The Texas Company's pipe line pump station at Fillmore, California.

This new installation will premit The Texas Company to transport crude oil from the Ventura district to the Los Angeles Basin refinery area, for processing into petroleum products for military and domestic requirements.

The proposed new pipe line facility of The Texas Company will provide additional pipe line transportation for 15,000 bbl per day and will augment the existing Ventura district-Los Angeles, California area pipe line capacity accordingly.

Plains Pipe Line Company System Will Be Extended

Mainline extension of the Plains Pipe Line Company system to the Stanton area of Martin County, Texas, and the Denton area of Lea County, New Mexico, is announced by D. M. McBride, president, and C. S. Mitchell, vice president, Bartlesville, Oklahoma, of the Plains Pipe Line Company.

Twenty miles of main line will be built from the Phillips Pipe Line Company system in the Wasson area of Yoakum County, Texas, into the Denton area of eastern Lea County, New Mexico, and northward along the Denton producing trend.

Plans call for a 9-mile extension of the line from the Germania pool of Midland County, Texas, to the Stanton area of southeastern Martin County, Texas.

The Plains Pipe Line Company is owned by Phillips Petroleum Company and Cities Service.

30-Mile Pipe Line for Midland County, Texas

A contract has been awarded by Texas-New Mexico Pipe Line Company to Carl H. Dunn, Fort Worth contractor, for construction of approximately 30 miles of pipe line in Midland County, Texas, it is announced by R. B. McLaughlin, president of the pipe line company.

The crude oil pipe line, 27 miles of which will be 8⅝ in. in diam. and 2.70 miles 6⅝ in., will connect the Scharbauer and Sweetie Peck fields with the Midland station of the Basin Pipe Line System.

Underground Storage for Mississippi River Fuel

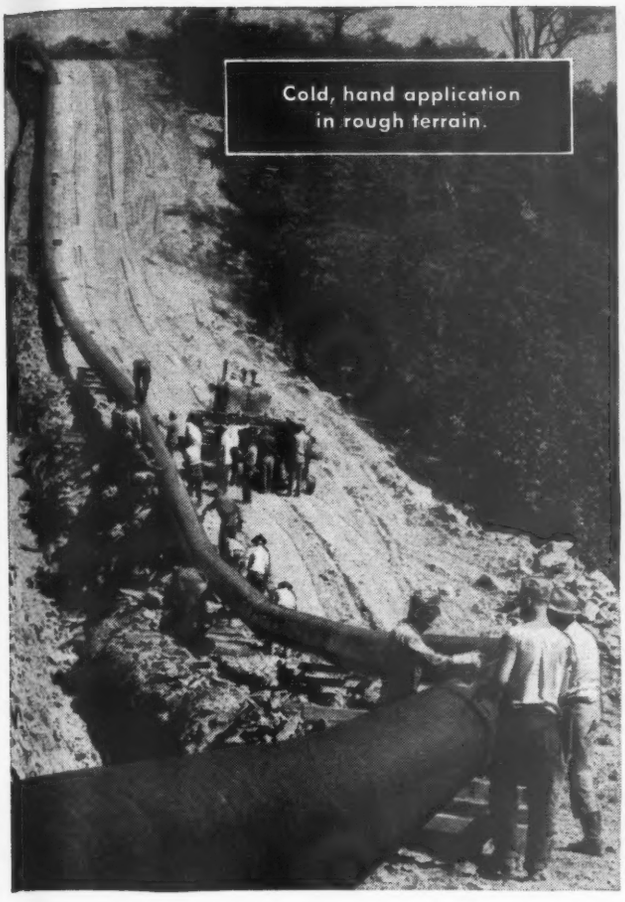
The Federal Power Commission has issued a certificate of public convenience and necessity authorizing Mississippi River Fuel Corporation to construct and operate natural gas underground storage facilities in the Waterloo oil field in Monroe County, Illinois, about 6 miles from the company's Columbia measuring station and near its major market area in and near St. Louis, Missouri.

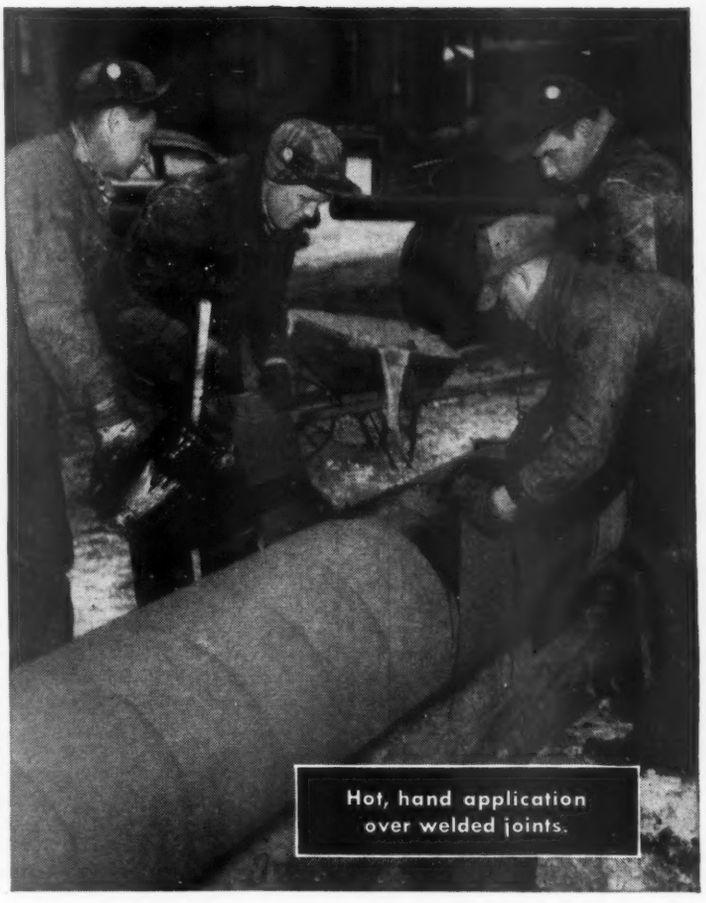
Reservoir capacity of the storage project is estimated at 13,284,000,000 cu ft; cushion gas required 1,329,000,000 cu ft, leaving available for market 11,995,000,000 cu ft. After the reservoir has been filled, the company estimates that a daily deliverability of 50,000,000 cu ft can be obtained through the proposed 25 wells, on intermittent occasions, but that continuous withdrawals for more than a few days would probably reduce the daily deliverability of the edge wells and possibly all of the withdrawal wells. There is evidence indicating, however, that if the storage reservoir capacity developed approximates the currently estimated potential of about 13.2 billion cu ft, the daily storage deliverability through the proposed 25 wells will not be less than 100,000,000 cu ft per day.

The company plans to construct by December, 1951, all proposed facilities except a 24-in. diam pipe line and a dehydration plant. This plant may not be necessary if it is found that the gas stored does not need dehydration. The commission deferred action on this plant and pipe line, deciding that evidence concerning them and related matters should be presented at a hearing in Washington commencing June 2, 1952.

Estimated cost of the gas storage facilities authorized is about $2,000,000.

The commission's order provides that construction begin as soon as possible and be completed by January 1, 1952.





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add life time to pipe lines

For long-term, low-maintenance underground service, NO-OX-ID and NO-OX-IDized Wrappers can be applied by hand as shown above. This method is especially adapted to application over rough terrain, on short lines or congested areas and on field joints after welding.

COLD METHOD: A pliable, plastic, cold NO-OX-ID is rubbed on to 1/32" thickness.

NO-OX-IDized Wrapper is applied spirally as a shield, keeping the NO-OX-ID in intimate contact with the pipe—providing a tight seal against moisture and preventing abrasive damage. Then a final coating of NO-OX-ID is brushed on.

HOT METHOD: A length of NO-OX-IDized Wrapper is used as a granny rag to apply hot NO-OX-ID. The wrapper is then sealed to the coating around the pipe for permanent protection.

Consult your Dearborn Engineer for the NO-OX-ID combination and method of application best suited to protect your next pipe job.

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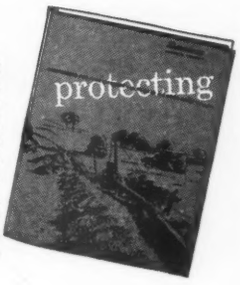

This informative illustrated book, "Protecting Underground Pipe from Corrosion with NO-OX-ID and NO-OX-IDized Wrappers," describes the hand application, traveling machine and stationary machine methods. Also contains coverage tables on each. The coupon is for your convenience.

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To Abandon and Transfer Gas Compressor Units

The Federal Power Commission ordered that a ceritficate of public convenience and necessity be issued authorizing Hope Natural Gas Company, of Clarksburg, West Virginia, to abandon and transfer certain gas engine units and auxiliary equipment from various other stations to its Bridgeport and Craig stations. It is also authorized to sell or salvage a number of gas engines and other units now unusable at its Bristol, Hawkins, Jack Evans, Lightburn, McMillan, Milford, Peora, Salem, Ward, Brinkmier, and Wolf Summit stations.

No curtailment of natural gas service will occur by reason of this abandonment or transfer, the company states.

Southeastern Missouri System to Expand

The Federal Power Commission has granted final authorization to Associated Natural Gas Company, of Tulsa, Oklahoma, to construct natural gas pipe line facilities that will extend service to 13 additional towns in southeastern Missouri.

The company, which presently serves Sikeston and New Madrid, Missouri, will build approximately 88 miles of new line and appurtenant facilities to transport natural gas for distribution and sale in Chaffee, Benton, East Prairie, Morehouse, Charleston, Lilbourn, Bloomfield, Essex, Bernie, Kennett, Holcomb, Clarkton, and Malden.

The total estimated cost of the project is $2,425,042.

Associated Natural has executed contracts with Texas Eastern Transmission Corporation, of Houston, Texas, for the purchase of 4,500,000 cu ft of gas per day. Associated will transport approximately 1,286,250,000 cu ft annually, with an estimated daily maximum demand of 4,400,000 cu ft in the fifth year for consumption in the 13 communities and in Sikeston and New Madrid.

Temporary authorization for the construction of the facilities was granted by the FPC on June 29, 1951.

Hearing Underway on Mid-South Proposal

The Federal Power Commission opened a consolidated hearing August 27 in Washington, D. C. on two applications of MidSouth Gas Company, of Little Rock, Arkansas, involving the proposed construction and acquisition of natural gas pipe line facilities in Arkansas.

One of the applications (G-1445) proposes the construction of a natural gas transmission system, consisting of about 240 miles of pipe, in Green, Poinsett, Crittenden, St. Francis, Lee, Phillips, Monroe, Woodruff, and Cross Counties, Arkansas.

The other application (G-1680) is for authority to acquire a 38-mile natural gas pipe line now being constructed in Arkansas by Arkansas Power and Light Company, of Pine Bluff, Arkansas. The proposed line extends from a connection with the facilities of Texas Gas Transmission Corporation near Helena, Arkansas, to Arkansas Power's Hamilton Moses steam electric generating station near Palestine, Arkansas.

United Changes Plans on Line in Gulf of Mexico

The Federal Power Commission has authorized United Gas Pipe Line Company, of Shreveport, Louisiana, to alter its plans on a natural gas pipe line to be built in the Gulf of Mexico off the coast of Louisiana, a change which will save 247 tons of pipe and $128,000 in construction cost.

The company will build approximately 11 miles of 14-in. line instead of 12.3 miles of 14-in. line as previously authorized. Under the new plans, the line will originate at United's platform in Block 32 approximately 1000 ft from the Pure Oil Company's drilling platform and extend southwest to a platform operated by Magnolia Petroleum Company, Continental Oil Company, and Newmont Oil Company in Block 51.

As previously authorized, the line was to have originated at the Pure Oil Company's platform in Block 32 and extended southwest to a platform operated by Magnolia, Continental, and Newmont Oil Company. Cost of that construction was estimated at $1,279,657.

California Gas Line Is Half Completed

Work on the 24 mile section of 30-in. pipe line being built jointly by Southern California Gas Company and Southern Counties Gas Company from 104th Street and Crenshaw Boulevard in Los Angeles to Burbank Boulevard and Lindley Avenue near Encino is progressing right on schedule, according to the latest report from the engineering department.

At the present time, pipe line crews are working on three spreads along the route of the line and have completed 12 of the 24 miles. Work on the line was begun early in June and is expected to be completed by mid-October.

One spread being worked by an Alex Robertson Company crew west and north from the present terminus of the Rivera-Los Angeles 30-in. line at 104th Street and Crenshaw Boulevard, has now progressed approximately 4 miles through the Inglewood and Hawthorne areas and is entering the Westchester district.

A second spread, also being worked by an Alex Robertson Company crew, has progressed about two miles south and east from Sunset Boulevard and Mandeville Canyon in the Brentwood area. Ultimately, the two Robertson crews will meet near Venice Boulevard in the Palms area.

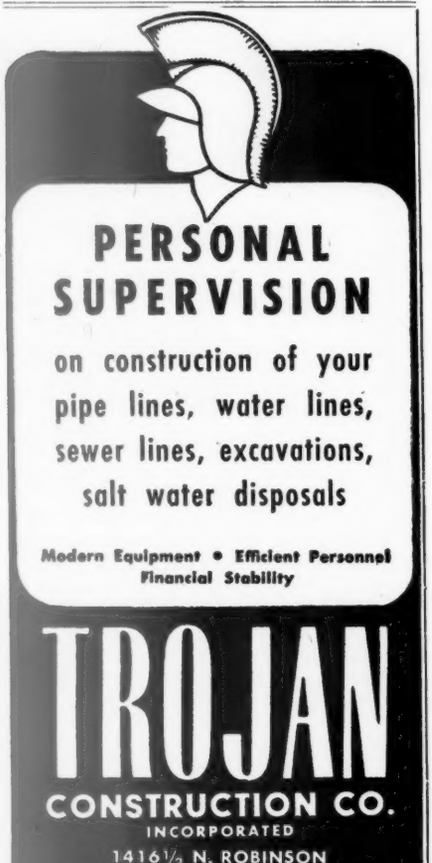
The third spread, which is being worked by an Engineers Limited Pipeline Company crew, has now completed approximately 4.5 miles of its 6.5 mile section of the job. Beginning in the Brentwood area, this section of the line has now progressed some 4.5 miles through the Santa Monica mountains and will eventually terminate near Encino, where it will tie into existing lines coming south from Goleta and Ventura, California.

El Paso Natural Applications Consolidated

The Federal Power Commission has consolidated two more applications of El Paso Natural Gas Company, of El Paso, Texas.

The two new El Paso applications propose the construction of a 1980-hp compressor station near Shell Oil Company's TXL plant in Ector County, Texas, and an 1100-hp compressor station near Phillips Petroleum Company's gasoline plant in Gaines County, Texas. Cost of the proposed facilities is $453,000 and $291,000, respectively.

In a previous application, El Paso proposed a $23,250,000 construction program in Arizona, New Mexico, and Texas, and asked authority to build facilities to increase deliveries to the Phoenix, Arizona, area. Nevada Natural Gas Pipe Line Company, of Las Vegas, whose hearing is consolidated with El Paso's, asked permission to build a 114-mile pipe line, at an estimated cost of $2,331,350, from Topock, Arizona, to Las Vegas. The company is seeking a supply of natural gas from El Paso.



With the PIPE LINE CONTRACTORS

J. L. Cox and Son, Raytown, Missouri, (stringing contractors), will string 423 miles of 20-in. on the Platte Pipe Line Company system. This is broken up in two sections, 273 miles from West Alton to Kenmoor, Missouri, and 150 miles from Holdrege to Odell, Nebraska.

For Service Pipe Line Company, 94 miles of 6 and 10-in. loops are being strung in Missouri and Illinois. For the same company, 66 miles of 10-in. pipe are being strung from the Salt Fork of the Brazos River to Bowie, Texas.

Ray L. Smith and Son, Inc., Hazlett Building, El Dorado, Kansas, is now working out of Aurora, Illinois, on the Texas Illinois Natural Gas Pipeline Company job. This contractor is laying 58 miles of 20-in. between Joliet and the Volo meter station. The following personnel are in charge: R. M. Jones, superintendent; D. L. Marley, office manager; Charles Lewis, welders' foreman; Carlos Gayhart, pipe; Charles Pierce, dope; C. N. Leggitt, ditch; "Hub" Cisco, bending, and Rex Pickens, lowering-in.

Latex Construction Company of Georgia, Box 56, Northside Branch, Atlanta, Georgia, has the contract for pump station and terminal work for the Plantation Pipe Line Company. Station buildings are being enlarged to house additional units at Baton Rouge, Louisiana; Collins, Mississippi; Akron and Silver Run, Alabama; Bremen and Center, Georgia, and Spartanburg, South Carolina. Terminals are being enlarged at all main points between Baton Rouge and Charlotte, North Carolina.

Dunn Brothers, 801 Mercantile Securities Building, Dallas, Texas, (stringing contractors), have the following jobs under contract:

Texas Illinois Natural Gas Pipeline Company, Section 5, 91 miles of 30-in. from Urbana to Dotson, Texas, and Section 6, 99 miles from Dotson to the Texas-Arkansas state line.

El Paso Natural Gas Company, 415 miles of 24-in. in New Mexico and Arizona on the San Juan line.

El Paso Natural Gas Company, 419 miles of 30-in. in New Mexico, Texas, and Arizona.

Northeastern Gas Transmission Company, 65 miles of 16-in. in Connecticut and Massachusetts.

Tennessee Gas Transmission Company, 95 miles of 30-in. from Drew to Holly Springs, Mississippi.

Tennessee Gas Transmission Company, 60 miles of 30-in. from Colesburg to Dickson, Tennessee.

Tennessee Gas Transmission Company, 60 miles of 30-in. from Salt Lick to Richmond, Kentucky.

H. L. Gentry Construction Company, 921 East Michigan Avenue, Jackson, Michigan, is doing considerable city work at Toledo, Fostoria, and Parma for the Ohio Fuel Gas Company. The spreadmen are Newton Dukes at Toledo, A. J. Brown at Parma, and Milo Larsen at Fostoria.

Ten meter runs and bypasses are being installed for United Natural Gas Company at its Bradford, Pennsylvania, compressor station. Ronald Stowers is in charge. James G. Mitchell is general superintendent over all the above work.

For Equitable Gas Company, 13 miles of 16-in. pipe are being laid, including a crossing of the Ohio River. Frank Morris and Lavern Curtis are in charge.

Work began in August on 32 miles of 20-in. pipe line for United Fuel Gas Company near Charleston, West Virginia.

L. E. Farley, Inc., 516 Chronicle Building, Houston, Texas, recently contracted to lay 64 miles of 10-in. pipe for the Gulf Refining Company. The line extends from Eucutta to Lumberton, Mississippi, and the field office is at Laurel. Glen Allman is superintendent and Wallace Campbell office manager.

Williams Brothers Company, National Bank of Tulsa Building, Tulsa, Oklahoma, has the following jobs in progress or contracted:

For Plantation Pipe Line Company, 712 miles of 14 and 18-in. pipe line from Baton Rouge, Louisiana, to Charlotte, North Carolina. George Allen is general superintendent. The central office is at Tuscaloosa, Alabama. Spread offices are located as follows:

Athens, Georgia—T. E. Davis, superintendent; J. E. G. Jester, office manager.

Bay Springs, Mississippi—A. T. Maxwell, superintendent; Joe Breedlove, office manager.

Kentwool, Louisiana—O. R. Mitchell, superintendent; R. J. Purdy, office manager.

For New York State Natural Gas Corporation, 78 miles of 20-in. from South Bend, Pennsylvania, to Petersburg, on the Pennsylvania-Ohio state line. The field office is at Leechburg, Pennsylvania. Clyde Gregory is superintendent and Walter Hammond office manager.

For East Ohio Gas Company, 65 miles of 26-in. from Cleveland to Petersburg, Ohio.

For Venezuelan Atlantic Transmission Corporation, 195 miles of 10, 12, and 16-in. from Las Mercedes to Caracas.

For Shell Caribbean Petroleum Corporation, 160 miles of 30-in. from Palmerejo, near Maracaibo, to Punta Cardon, Venezuela. Both projects are under the supervision of Marvin Jones, who has his headquarters at Caracas.

R. H. Fulton and Company, P. O. Box 1526, Lubbock, Texas, has begun work on 250 miles of 20-in. for the Colorado Interstate Gas Company, extending from Kit Carson, Colorado, to the Canadian River north of Amarillo, Texas. The field office is at Lamar, Colorado. Jerry Nash is superintendent and Harry Jones office manager.

A second spread got underway in August at Stratford, Texas, with Ed Veach the superintendent.

Also started is the 124 miles of 20, 24, and 26-in. loops being laid for Northern Natural Gas Company between Sneed, Texas, and Olpe, Kansas. Field headquarters are at Dodge City, Kansas. M. L. Boyd is superintendent.

As much work is being done as possible on the Platte Pipe Line Company project with the limited amount of pipe received. The contractor will lay a total of 570 miles of 16 and 20-in. pipe between Chatham station in Wyoming and Brule, Wyoming.

Reese Brothers Construction Company, Hugoton, Kansas, is installing a gathering system for Northern Natural Gas Company in Texas County, Oklahoma, and Kearny, Finney, Haskell, Seward, and Morton counties, Kansas. In all, 181 miles will be laid, consisting of 4, 6, and 8-in. diam pipe.

For Hugoton Production Company, 50 miles of 4-in. through 22-in. gathering lines are being laid in the Hugoton area.

Mahoney Contracting Company, 2300 North Grand River, Lansing, Michigan, is laying 100 miles of 30-in. pipe for Texas Eastern Transmission Corporation from the Kentucky River to the Ohio River in northeastern Kentucky. This work is in charge of Barney Finnerty with the field office at South Shore, Kentucky.

Also for Texas Eastern, 30 miles of 30-in. pipe is being laid from Connelsville, Pennsylvania, to the Oakford storage area near Greensburg, Pennsylvania. The field office is at the latter point. Henry Mogg is superintendent.

Crews and equipment have been moved in to make the Lake Maracaibo and Gulf of Coro crossings for Shell-Venezuela, S.A., but actual work is being held up awaiting settlement of certain matters with the Venezuelan government. The Lake Maracaibo crossing will be a 10-miles long and 20-in. diam pipe. The Gulf of Coro will be 4 miles in length and consist of 30-in. pipe. Both jobs will be in charge of Angelo Tavernaro.

Work is underway for Dow Chemical Company consisting of 70 miles of 8-in. through 24-in. pipe in the Bay City, Midland, and Saginaw, Michigan, areas. Ralph Bucher is superintendent. The field office is at Midland.

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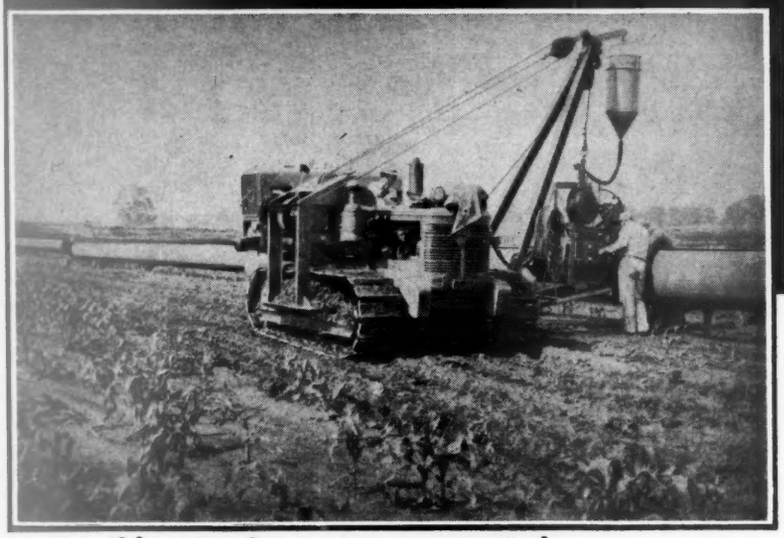

This O. R. SMITH Submerged Arc Welding unit made up to 87 welds per day on the 26-inch line of the Trunkline Gas Company, Illinois.

High Quality Welds plus Efficient Operation!

The adaption of the O. R. Smith factory submerged-arc welding to field conditions has continued to maintain the highest qualities associated with this process. Numerous physical tests made on the line, and extensive X-ray examinations show that welds produced with the O. R. Smith unit are consistently high in quality and meet the most exacting inspection requirements.

For accurate and positive control over the quality of welding, O. R. Smith machines are equipped with meters which indicate the actual welding amperage, voltage, and welding speed. As a result of this precise control the O. R. Smith submerged-arc welding units produce welds with perfect fusion between the pipe and electrode. The flux coating retains heat in the weld long enough to insure perfect grain refinement, and give metal enhanced physical properties.

This O. R. Smith equipment makes possible the use of multiple joint sections of 2, 3, 4, 5, 6 or more joints. This new approach speeds the rate of pipeline construction which results in a reduction in the total overhead and operating expense. The table below illustrates how a tie-in crew making 50 welds per day can produce much greater footage by using multiple joint sections instead of mill lengths. For example, the welding time on 26-inch pipe is 4½ minutes, the handling time only one minute, thus making it possible to produce 85 to 100 welds per day with one O. R. Smith machine. Transportation costs of jointed sections are eliminated since sections are made down the right-of-way in the exact position where they are required.

Another highly important use for the O. R. Smith unit is for welding river crossing pipe. Here the increased wall thickness allows more welding time in proportion to set-up time, the handling being approximately the same regardless of wall thickness.

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Table Showing How Daily Footage is Increased Using Multiple Joint Sections

Scheduled Rates of Construction Using 40-ft. Joints	Total No. Welds Req. Per Day	Using 2-Joint 80-ft. Sections		Using 3-Joint 120-ft. Sections		Using 4-Joint 160-ft. Sections	
		Hand Weld	Auto. Mach. Weld	Hand Weld	Auto. Mach. Weld	Hand Weld	Auto. Mach. Weld
4,000 ft. per day	100	50	50	34	66	25	75
6,000 ft. per day	150	75	75	50	100	37	113
8,000 ft. per day	200	100	100	66	134	50	150

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Bechtel Corporation, 220 Bush Street, San Francisco, California, is proceeding with its work on 409 miles of 30-in. in Arkansas and Missouri for Texas Illinois Natural Gas Pipe Line Company. The project office is at 409 East Markham Street, Little Rock, Arkansas. E. W. Davis is division manager, R. Hamilton assistant project manager, E. G. Hayes division office manager, G. R. Curtis, project engineer, and E. C. Elting project office manager.

Spread offices are as follows:

Newport, Arkansas, general delivery —B. C. McLean, office manager.

Bald Knob, Arkansas, general delivery—S. L. Work, superintendent, C. A. Bingaman, office manager, and G. D. Page, job engineer.

Malvern, Arkansas, general delivery —V. L. Williams, superintendent, Harry Sager, office manager, and R. H. Hall, job engineer.

Arkansas River crossing, Box 349, North Little Rock, Arkansas—George Wahlgren, superintendent.

Jackson, Missouri, Box 10 — C. E. Barker, assistant project manager; R. W. Jernigan, superintendent, E. C. Gavagan, office manager, and M. P. Boyle, job engineer.

Pocahontas, Arkansas, Box 122 — J. F. Borger, superintendent; R. L. McElroy, office manager, and W. L. Clark, job engineer.

Bechtel Constructors, Inc., 220 Bush Street, San Francisco, California, is laying 120 miles of 24-in. pipe for Tennessee Gas Transmission Company from Hamburg, New York, to the Hudson River. The work is in progress. The project office is at Richfield Springs, New York, P. O. Box 789. R. L. Bowman is general superintendent; W. H. Molander office manager.

Oman Construction Company, Inc., Box 146, Nashville, Tennessee, has under construction 79½ miles of 30-in. pipe line in Kentucky for Texas Eastern Transmission Corporation. The field office is at Columbia. M. W. Smith is superintendent.

River Construction Corporation (formerly Texas-Louisiana, M-K Company), P. O. Box 9127, Arlington Heights Station, Fort Worth, Texas, has opened an office at Columbia, Mississippi, and is moving in men and equipment to make a river crossing for the United Gas Pipe Line Company. Jimmy Reid will be the spreadman.

Lack of pipe is holding up work on 215 miles of 30-in., 42 miles of 24-in., and 100 miles of various size pipe from 20-in. down for United from Lafayette and Napoleonville northeast to connect with Texas Eastern Transmission Corporation's system north of Jackson, Mississippi. The field office is at Donaldsonville, Louisiana. H. J. "Red" Tatom is superintendent and A. L. Price office manager.

Williams-Austin Company, Grant Building, Pittsburgh, Pennsylvania, will complete the following work between November 15 and December 15:

New York State Natural Gas Corporation, 39 miles of 16-in. from Amsterdam to Albany and Knox, New York. The warehouse and office are at Schenectady, the telephone 7-3423. Leman Creech is superintendent.

Also for New York State Natural, 56 miles of 20-in. between Morrisville to Ithaca, New York. Ralph Gaddy is superintendent and headquarters are at Cortland, New York.

Niagara Mohawk Power Corporation, 12 miles of 10 and 16-in. laterals in the Schenectady and Albany areas. Howard Bauer is in charge of the work, with the field office at Schenectady.

The above jobs are all in progress. The following have not yet started:

New York State Natural Gas Corporation, 37 miles of 20-in. from Lawrenceville, Pennsylvania, to Ithaca, New York. This job will start about September 10 with Leman Creech in charge. The warehouse and office will be at Lawrenceville, telephone 24.

Aftr this job has been completed, Creech and his crew will move their headquarters to Wellsville, New York, to lay 23 miles of 20-in. for New York State Natural from State Line Station to Wellsville.

Ed Peters is general superintendent over all work.

Bishop and Lock Construction Company, 1018 Magnolia Building, Dallas, Texas, is waiting on pipe to begin the Platte Pipe Line Company job, 142 miles between Marysville, Kansas, and Holdrege, Nebraska.

Oklahoma Contracting Company, 6512 Hines Boulevard, Dallas, Texas, on August 20, lacked 27 miles of main line but still had 90 miles of laterals to lay on the Northeastern Gas Transmission Company job. The overall contract covered 175 miles of 24-in. main line from a point near Albany, New York, to Wilmington, Massachusetts, and 110 miles of laterals in pipe sizes from 3 in. through 12 in. The work is expected to be completed in late October or early November.

The central headquarters have been moved from Springfield to Framingham, Massachusetts, where W. H. Law is in charge. Spread headquarters are as follows:

Lowell, Massachusetts—H. A. "Red" Wiley, superintendent.

Framingham, Massachusetts—M. E. "Panama" Shifflet, superintendent.

Sturbridge, Massachusetts—J. E. "Ed" Flanagan, superintendent.

Oxford, Massachusetts—Louis Visentine, superintendent.

At Florence, Alabama, a crossing is being made of the Tennessee River for Brown and Root, Inc., on the Texas Eastern Transmission Corporation system. Officials in charge are Paul Halbert, Aldress Kilgore, and Harry Prindle.

Brown and Root, Inc., P. O. Box 3, Houston, Texas, is laying 88.7 miles of 6⅝-in. pipe for United Gas Pipe Line Company between Chalmette and Venice, Louisiana. J. W. Kincy is superintendent and E. R. Jackson spreadman. The field office is at Harvey, Louisiana. T. M. Strong is office manager.

The company also has a contract with United covering various phases of engineering, construction, and other services on more than 1000 miles of pipe line in Texas, Louisiana, and Mississippi.

Williams Brothers-Davis Company, 6006 Jensen Drive, Houston, Texas, is laying 165 miles of 30-in. pipe line from Kosciusko, Mississippi, to Florence, Alabama, for the Texas Eastern Transmission Corporation. The field office is at Ackerman, Mississippi, with Dick Hamilton the superintendent.

H. B. Zachry Company, P. O. Box 2570, San Antonio, Texas, is presently engaged in laying 74 miles of 30-in. pipe for Texas Eastern Transmission Corporation, from a point near Columbia, Tennessee, to the south side of the Cumberland River in northern Tennessee.

Eastern Pipe Line Contractors, 1801 Mercantile Bank Building, Dallas, Texas, had laid approximately 17 miles (August 16) on the Texas Eastern Transmission Corporation job. The contract covers 76 miles of 30-in. from the Tennessee River near Florence, Alabama, to a point near Columbia, Tennessee. Laying was held up for a time because the pipe gang caught up with the right-of-way crew and ditchers. The field office is at Florence. Fred Byers is general superintendent and Cliff Simmons spreadman.

Associated Pipe Line Contractors, Inc., 3272 Westheimer Road, Houston, Texas, has recently received a contract from Southern Natural Gas Company for the construction of 40 miles of 24-in. double loop line. The pipe will be laid at several points in Louisiana and Mississippi. The field office is at Rolling Fork, Mississippi. Wm. Briley is superintendent and R. N. Cain office manager.

The contractor also is installing the Mississippi River crossing for Mid-Valley Pipeline Company, operating from the Rolling Fork office.

Other jobs by this contractor are:

United Gas Pipe Line Company, 100 miles of 20, 24, and 26 in. in the New Orleans area. This work is being done in conjunction with J. Ray McDermott and Company. The field office is at Morgan City, Louisiana. J. A. Williamson is general superintendent, L. H. Gray spreadman, Ralph Herwig and James Luther office managers.

U. S. Corps of Engineers, 188 miles of 6⅝-in. from Searsport to Limestone, Maine. The field office is at Houlton. Cecil Rogers is superintendent and A. B. Johnson office manager.

Western Pipe Line Construction, Inc., Lockhart Building, Austin, Texas, has under construction for Tennessee Gas Transmission Company, 121 miles of 30-in. between Parsons, Tennessee, and Salt Lick, Kentucky. Two spreads are at work. One has its field headquarters at Richmond, Kentucky, with W. B. Williams superintendent and P. O. Rutledge office manager. This spread will lay a total of 62 miles. The other spread is working from Linden, Tennessee, and is in charge of Jack Hodges with A. G. Goyne office manager.

Three river crossings also are being installed, the Duck, Buffalo, and Tennessee.

Smith Contracting Corporation, 205 Northwest Seventh Street, Fort Worth, Texas, has laid 33 miles (August 20) of the 57 miles of 10-in. for Service Pipe Line Company between the Salt Fork of the Brazos River near Throckmorton, Texas, to Humble's Jud station near Haskell. The field office has been moved from Throckmorton to Haskell, where the contractor also is operating a reconditioning yard. Herb Smith is superintendent, Jim McKnight spreadman, and John Briggs office manager.

Anderson Brothers Corporation, 707 North Drennan Street, Houston, Texas, had completed 75 per cent (August 30) of the pipe line being laid between Big Rapid and Farmington, Michigan, for Michigan Consolidated Gas Company. This consists of 121 miles of 24-in. Two spreads are pushing the work. One has its headquarters at Clare, Michigan, where J. F. Whitlow is the superintendent; the other as Owasso, Michigan, Lewis Knox being in charge at that point.

The Panhandle Eastern Pipe Line Company job, 75 miles of 26-in. and 12 miles of 20-in. between Blissfield and Detroit, Michigan, is 90 per cent completed. Hank Putty is in charge of the spread working out of Flat Rock and Rusty Killingsworth is supervising the work from the field office at Blissfield.

Approximately 90 per cent completed is the 68 miles of 30-in. for Tennessee Gas Transmission Company from Horse Cave to Campbellsville, Kentucky. The field office is at Glasgow with E. E. McCoy the superintendent.

The 90-mile section of 30-in. for Tennessee Gas, from Drew to Holly Springs, Mississippi, is 80 per cent completed. The field office is at Batesville and Earl Saulsman is the superintendent.

Laying of pipe was begun in August on 100 miles of 24-in. for the Algonquin Gas Transmission Company, from Hartford, Connecticut, to Boston, Massachusetts. The field office is at Glastonbury, Connecticut. Ray Bendure is superintendent. A second spread will have its headquarters at Thompson, Connecticut, details to be announced later.

The Triangle Pipe Line Company job is about 50 per cent completed, two spreads being in operation. The spread in charge of Red Williams is working out of Dermott, Arkansas, and the one under the supervision of Dick Plake out of Warren. The line consists of 85 miles of 10-in. and extends from El Dorado to Arkansas City, Arkansas. It will be used for the transportation of petroleum products.

A new job is 40 miles of 16-in. for the Pan American Gas Company. D. C. Pope is in charge of a spread working from Texas City, Texas.

All pipe has been laid on the Trunkline Gas Company project. Testing work is now being done with Jim Folk in charge.

Parkhill Truck Company, P.O. Box 1856, Tulsa, Oklahoma, issues this work in progress report as of August 15:

417 Miles of 30-in., Texas Illinois Natural Gas Pipeline Company for Bechtel Corporation from Texarkana, Arkansas, to the Mississippi River near Cape Girardeau, Missouri. R. M. Hiser, foreman, Section 8; Frank Laubach, Section 7; Charles Sampson, Section 10.

300 miles of 30-in. on Texas Illinois line for Midwestern Constructors from Mississippi River to Joliet, Illinois. Harold Deatherage and Jimmie Stubblefield, foremen.

60 miles of 26-in. for Anderson Brothers Corporation on Panhandle Eastern Pipe Line Company in Indiana and Illinois. Ray Herron, foreman.

70 miles of 3-in. for Conyes Construction Company on Panhandle Eastern Pipe Line Company in Indiana and Illinois. O. C. "Bud" York, foreman.

160 miles of 24-inch for Anderson Brothers on Michigan Consolidated Gas Corporation from Detroit to Big Rapids, Michigan. Cecil York and F. L. Bridges, foremen.

60 miles of 20-in. on Texas Illinois line for Ray L. Smith and Sons, from Joliet to Elgin, Illinois. Curtis Williams, foreman.

85 miles of 10-in. on Triangle Pipe Line for Anderson Brothers Corporation from El Dorado, Arkansas, to Arkansas City, Arkansas. H. C. Peterson, foreman.

57 miles of 10-in. for Service Pipe Line Company, from a point near Rochester, Texas, to the Brazos River, near Olney, Texas. Dewey Prater, foreman.

N. A. Saigh Company, Inc., Suite 531 Majestic Building, San Antonio 5, Texas, is laying 80 miles of 30-in. pipe line for Texas Eastern Transmission Corporation from Columbia to Boonesville, Kentucky. Work began in July. The field office is at 109 North Central Avenue, Campbellsville, Kentucky. Telephone: 373. Carl Doyle is superintendent, Hubert Hutchins and Raymond Doyle assistant superintendents. The office manager is James E. Gray and the chief inspector Jesse Cobb. Foremen are: Carl Avrett, welders; J. N. Childress, dope; H. N. Russell, right-of-way; W. B. Uehling, stringing, and Charley Warren, pipe. James R. Scott is material man.

Anderson-Gibbs Company, 715 North Drennan Street, Houston, has begun work on a crossing of the Red River at Alexandria, Louisiana, for the Texas Gas Transmission Corporation. In addition, miscellaneous dredging work is being done for several companies in the Port Arthur, Texas, area.

Jayhawk Construction Company, Inc., Box 68, Great Bend, Kansas, has completed the 60-mile section of 8, 10, and 12-in. pipe line from Grand Island to Albion, Nebraska, for the Kansas-Nebraska Natural Gas Company, and now is ready to begin work on two other jobs for the same company. One is 40 miles of 6-in. between Albion and Norfolk, Nebraska, and the other 30 miles of 6-in. from Albion to Neligh.

Cheek Construction Company, P. O. Box 491, Ulysses, Kansas, is laying a gathering system for Cities Service Gas Company near Ulysses in the Hugoton field that consists of 101 miles of 6-in. to 22-in. pipe. Troy Cheek is spread foreman, Alton Cheek pipe foreman, Frank Holt office manager, and A. W. Charpist doping foreman.

George Tucker Pipe Line Construction, P. O. Box 1987, Odessa, Texas, is laying a 140-mile gathering system in West Texas for the Lion Oil Company of El Dorado, Arkansas. The system will connect with the Diamond "M"—Sharon Ridge gasoline plant about 10 miles from Snyder. Pipe sizes range from 6 to 30 in. The work is scheduled for completion about October 30.

H. C. Price Co., Pipeline Division, Box 1111, Bartlesville, Oklahoma, completed the first of August 156 miles of 24-in. high pressure natural gas pipe line for Tennessee Gas Transmission Company between Hamburg, New York, and the Onondaga-Madison county line.

The company has the general contract covering construction of approximately 193 miles of 30-in. gas pipe line for Texas Illinois Natural Gas Pipeline Company from the Trinity River northeastward to the Texas-Arkansas state line near Texarkana. Work was 80 per cent completed as of August 10. Spreads are located as follows:

Atlanta, Texas, Box 12, Telephone 210: C. E. Shivel, superintendent; D. H. Johnston, office manager; C. F. Jones and R. H. Edwards, right-of-way foremen; Ray Drewell, ditch; J. V. Huff, bending; Delbert Shivel, pipe; John Stokes, welding; Henry Hill, coating; Bill Buchanan, lower-in; Paul McCormack, clean-up; Boyd Danner, chief mechanic.

Livingston, Texas, general delivery, telephone 709: C. R. Ice, superintendent; G. A. Harvey, office manager; W. O. Elliott and Jessie Cash, right-of-way foremen; E. W. Whisenant, ditch; Forest Loinette, bending; W. T. Dickerson, pipe; L. O. Reutzel, welding; N. D. Adams, coating; J. C. Rich, lower-in; John E. Hamilton, clean-up; Cliff Birmingham, chief mechanic.

Midwestern Constructors, Inc., 105 North Boulder Street, Tulsa, Oklahoma, was nearing completion on Schedule 11 for Texas Illinois Natural Gas Pipeline Company (August 10). This schedule consists of 100 miles of 30-in. from the Mississippi River near Chester, Illinois, to Effingham. Mac Hoffman is superintendent at DuQuoin, Illinois, and John Work at Vandalia, Illinois.

The 100 miles of 30-in. from Effingham to Sibley was 10 per cent completed. This is Schedule 12.

Schedule 13, 92 miles of 30-in. from Sibley to Joliet, was 95 per cent completed. Denver Franklin is superintendent and the field office is at Monticello, Illinois.

For the Mississippi River crossing near Wittenberg, Missouri, the field office is at Grand Tower, Illinois. Howard S. Lipp is coordinator, Friday Davis superintendent in charge of pipe, and Ivan Steele office manager. Three 20-in. lines are being laid under the river, the work being 10 per cent completed.

The central office for the Texas Illinois work is at Decatur, Illinois. M. T. Wilhite is general superintendent and A. T. Tolbert, office manager.

Work of installing station additions and piping at three Panhandle Eastern Pipe Line Company stations was 95 per cent completed. At Tuscola, Illinois, F. C. Snavely is superintendent, and Morris D. Garey is office manager. At Zionsville, Indiana, J. A. Bard is superintendent. At Edgerton, Indiana, Earl S. Powell is superintendent and H. H. Voss office manager.

For Aluminum Ore Company, Bauxite, Arkansas, approximately 10,000 ft of 8-in. cast iron pipe is being installed. W. L. Daniels is superintendent and John Hoff, engineer. The job is 90 per cent completed.

H. C. Price Company, Somastic Division, Box 1111 Bartlesville, Oklahoma, is doing the following work:

East Coast Division (at Bustleton, Pennsylvania):

Consolidated Edison Company—Application of Somastic coating and internal cleaning and coating to approximately 13,400 ft of 8⅝-in. OD pipe and application of 2-in. Hevicote to same; application of Somastic coating and internal cleaning and coating to approximately 16,800 ft of 8⅝-in. OD pipe.

Phelps-Dodge Corporation—Application of Somastic coating and internal cleaning and coating to 7800 ft of 8⅝-in. OD pipe.

Philadelphia Electric Company—Application of Somastic coating to 500 ft of 20-in. OD pipe; 80,000 ft of 16-in. OD pipe, 3200 ft of 8⅝-in. OD pipe, and 3200 ft of 4½-in. OD pipe.

Philadelphia Gas Works Company—Application of Somastic coating to all pipe requirements from 1¼-in. to 30-in. for 1951.

Transcontinental Gas Pipe Line Corporation—Application of 1-in. super dense Hevicote over Somastic to 7200 ft of 12¾-in. OD pipe.

Consolidated Telegraph and Electric Subway Company—Application of Somastic coating and internal cleaning and coating to approximately 37,100 ft of 6⅝-in. OD pipe.

Sidney Samuels, Inc.—Application of Somastic coating to 3200 ft of 2 to 8-in. pipe.

Manufacturers Light and Heat Company—Application of Somastic coating to approximately 1500 ft of 14-in. OD pipe.

(At Staten Island, New York):

Transcontinental Gas Pipe Line Corporation—Application of 1½-in. Hevicote over Somastic to 9400 ft of 26-in. OD pipe; application of 3-in. Hevicote over Somastic to 8100 ft of 24-in. OD pipe.

(Gulf Coast Division (at Morgan City, Louisiana):

Gulf Southern Contractors (for United Gas Pipe Line Company)—Application of Somastic coating to approximately 26.3 miles of 30-in. OD pipe; 22.8 miles of 26-in. OD pipe; 24.6 miles of 24-in. OD pipe; 15.6 miles of 20½-in. OD pipe; 21.1 miles of 20-in. OD pipe; 13.4 miles of 16-in. OD pipe.

(At Harvey, Louisiana):

Brown and Root, Inc. (for United Gas Pipe Line Company)—Application of Somastic coating to approximately 60,000 ft of 14-in. OD pipe and application of 1-in. Hevicote to 60,000 ft of 14-in. OD pipe.

Western Pipe Coating Company, Inc., P. O. Box 181, Iola, Kansas, is coating over the trench 67 miles of 10-in. pipe between the Brazos River and Bowie, Texas. The job was sub-contracted from O. R. Burden Construction Corporation who is doing the work for Service Pipe Line Company.

Vaughn and Taylor Construction Company, Inc., Box 1351, Wichita Falls, Texas, is laying a 179-mile gathering system in the Ulysses, Kansas, area for Cities Service Gas Company. Pipe sizes range from 4 in. through 30 in. The field office is at Ulysses. D. D. Vaughn is superintendent and C. E. Sayles office manager.

Fulton and Brodie, Hugoton, Kansas, are laying 123 miles of 16, 20, 24, and 26-in. pipe for Northern Natural Gas Company. The construction extends from a point north of Ulysses, Kansas, to a point near Guymon, Oklahoma. The operating office is at Hugoton. E. H. Marley is superintendent.

Mid-States Construction Company, Inc., P. O. Box 417, Mount Vernon, Illinois, has under construction 13½ miles of 10-in. pipe for Texas Gas Transmission Corporation, tying into that company's 12-in. line and extending to the Alford storage field. Personnel as follows: Ray Koch, right-of-way and crossing foreman; "Dutch" Hall, ditch; Dan Flatt, pipe and bending; Claude Jones, welders; Glen Caldwell, dope, tie-ins, and lowering-in, and Paul Kelly, clean-up.

Houston Contracting Company, 2707 Ferndale Place, Houston, Texas, has the following construction work under contract:

Approximately 96 miles of 18-in. and 16-in. gas line for Mississippi River Fuel Corporation from vicinity of Ruston, Louisiana, to a point north of Marshall, Texas. Job is being done with two spreads as follows:

One spread starting at Ruston and working west. E. C. Norris, superintendent; R. E. Thornton, assistant superintendent; R. J. Axsom, office; headquarters, Arcadia, Louisiana. Approximately 17 miles had been completed to August 3.

Second spread started at Woodlawn, Texas, and is working east. F. A. Silar, superintendent; C. V. Oliver, assistant superintendent, L. F. Redfearn, office; headquarters, Marshall, Texas. Approximately 6 miles had been completed to August 3.

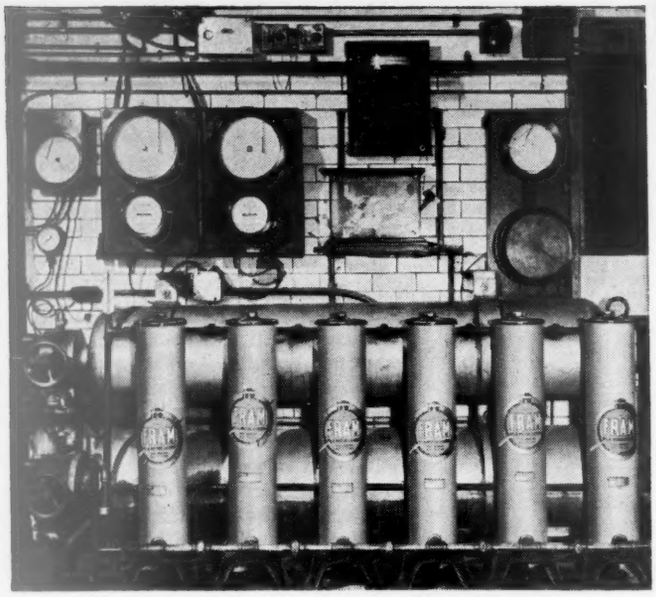
Approximately 130 miles of 12-in., 8-in., and 6-in. lay and take-up for Interstate Oil Pipe Line Company in the vicinity of New Iberia, Louisiana. H. L. Leake, superintendent; S. B. Harrison, assistant superintendent; H. C. MacWhinnie, office; headquarters, New Iberia, Louisiana. Approximately 30 miles completed.

Approximately 181 miles of 26-in. gas line for Texas Gas Transmission Corporation from vicinity of Bastrop, Louisiana, south to vicinity of Eunice, Louisiana. Starting date subject to Federal Power Commission permit but expected to be about September 1. Work will be done by three spreads with headquarters at Monroe and Alexandria, Louisiana.

Approximately 46 miles of 30-in. gas line for Tennessee Gas Transmission Company from the vicinity of Galion, Louisiana, south to vicinity of Eros, Louisiana, was completed August 10.

Gulf Southern Contractors, 516½ Louisiana Avenue, Shreveport, Louisiana, has contract to lay approximately 1000 miles of pipe line for United Gas Pipe Line Company in Louisiana, Texas, and Mississippi, including a marine line in the Gulf of Mexico. Gulf Southern is a contracting group composed of River Construction Corporation of Fort Worth, Texas, Oklahoma Contracting Company of Dallas, Texas, J. Ray McDermott and Company of New Orleans, Louisiana, and Morrison-Knudsen Company, Inc., of Boise, Idaho.

Rumsey Brothers Pipe Line Construction Company, M. and M. Building, Houston, Texas, are waiting on pipe to begin construction of 100 miles of the Platte Pipe Line Company system. The section will be from the Nebraska-Kansas state line near Lanham, Kansas, to the Missouri River near Doniphan, Missouri. Al Works will be in charge as superintendent and Wallace Hale will manage the field office.



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▸ **Conyes Construction Corporation,** 2884 San Pablo Avenue, San Pablo, California, has under construction 140 miles of 30-in. pipe line for Panhandle Eastern Pipe Line Company. One spread is laying the 75-mile section from Tuscola to Zionsville, Indiana. A second section is from Zionsville to Fort Wayne. Jimmy Allman and Morris Norwood are the superintendents.

▸ **G. G. Griffis Construction Company,** 2514½ East 15th Street, Tulsa, Oklahoma, has been underway since the middle of July on several loops for Northern Natural Gas Company. Overall 210 miles of 26-in. pipe will be laid in Texas, Oklahoma, Kansas, and Nebraska. The field office is at Beatrice, Nebraska. G. L. Mims is general superintendent, E. G. Grisham spreadman, and Mont Wood office manager.

▸ **Trojan Construction Company,** 1416½ North Robinson, Oklahoma City, Oklahoma, has contracted to lay 50 miles of 30-in. for the Texas Eastern Transmission Corporation from Ford to Moorehead, Kentucky. Work began in August. The field office is at Winchester with Charles T. "Swede" Tillotson, superintendent, Hubert Gragg, spreadman; Walter Wells, office manager.

For Shell Pipe Line Corporation, 54 miles of 10¾-in pipe is being laid between Cleveland and Chelsea, Oklahoma. This job has been on since July.

▸ **O. R. Burden Construction Corporation,** 6702 East 21st Street, Tulsa, Oklahoma, is laying 280 miles of the Platte Pipe Line Company system and is one of the two contractors to receive any pipe on this job. The others may not be able to get started until 1952, according to latest reports. Burden is constructing the section from the Missouri River near St. Joseph, Missouri, to the Mississippi River near Wood River, Illinois. Field headquarters are at Moberly, Missouri. Barney Hall is superintendent and Howard Smith office manager.

Working from Olney, Texas, 66 miles of 10-in. are being laid for Service Pipe Line Company between Bowie, Texas, and the Brazos River. A crossing of the Brazos is being made. Pete Hiner, superintendent; Ed Rensch, office manager.

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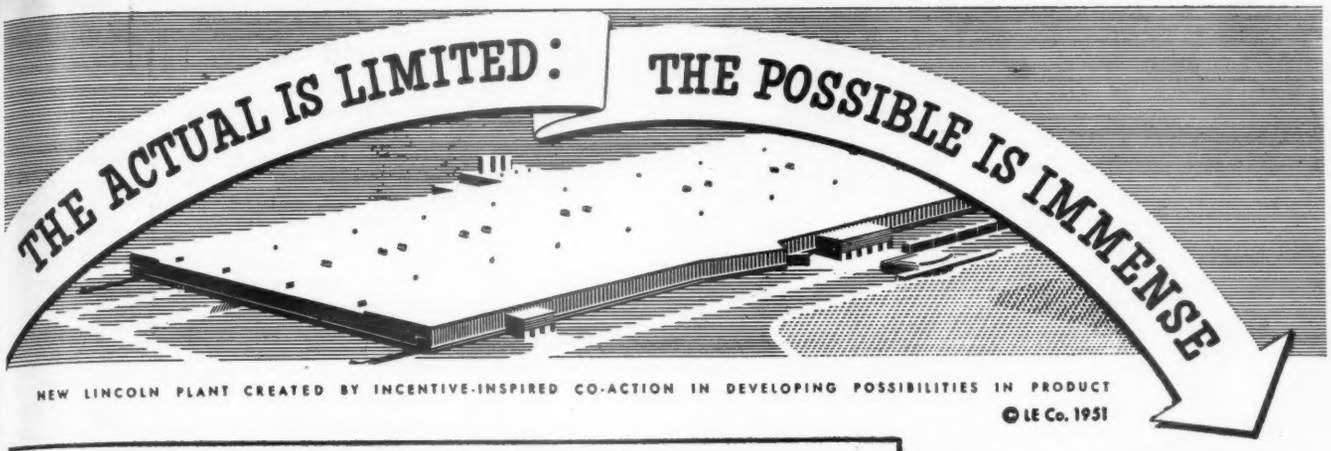

NEW LINCOLN PLANT CREATED BY INCENTIVE-INSPIRED CO-ACTION IN DEVELOPING POSSIBILITIES IN PRODUCT

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FABRICATOR INCREASES WELDING SPEED 5 TIMES

. . . gets stronger joints for less cost

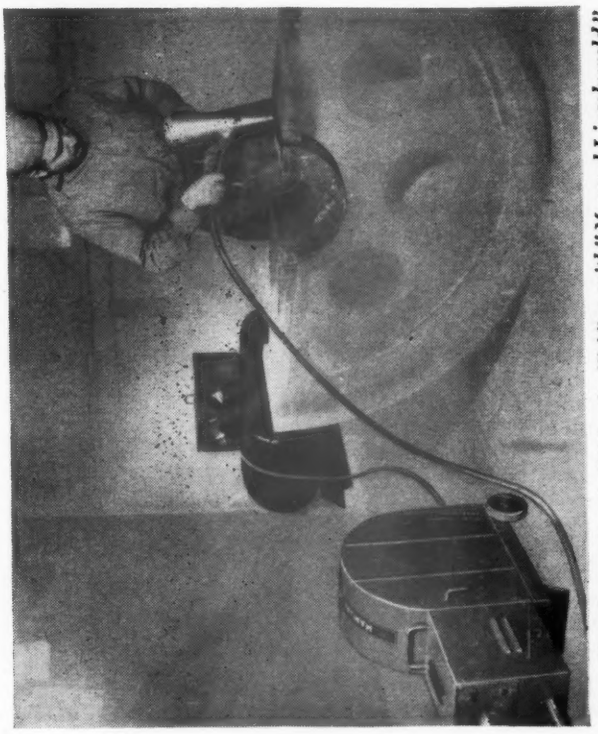

Fig. 3—High-Current-Density Hidden Arc Welding *with "Manual Lincolnweld."*

BY utilizing the economies of high-current-density hidden-arc welding, this pipe fabricator shown in Fig. 2 has increased welding speed 500% to reduce direct labor costs up to 30 per cent and largely eliminated rejects in critical, high-pressure pipe joints.

Such savings, possible in your plant also on a wide range of work, are a direct result of simpler welding with continuous electrode in granular flux . . . at speeds 2 to 5 times possible with coated electrodes. As a result of using an equivalent of 10,000 amps on a 7/16" electrode (obtained by concentrating up to 600 amps on a 5/64" continuous electrode) welds produced are stronger, have deeper penetration . . . need less weld metal.

"Manual Lincolnweld" eliminates the need for most joint preparation on plate size up to ¼" . . . produces most welds in a single pass to simplify your job and cut costs to a minimum.

the ACTUAL

Fig. 1—2½" per minute *hand welding of high pressure piping . . . 5 passes.*

increasing the YIELD

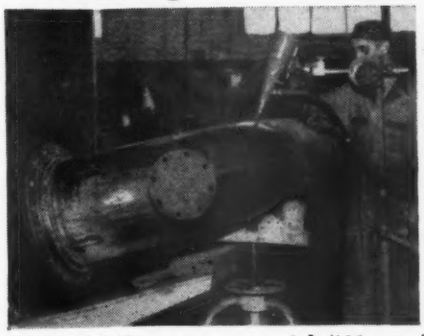

Fig. 2—18" per minute *with "Manual Lincolnweld" high-current-density welding . . . 3 passes.*

the IMMENSITY of the POSSIBLE

Direct Labor Cost Cut 30% . . . assembly limits held to within 1/8"

SEE HOW FABRICATOR GETS INCREASED PRODUCTION . . . FEWER REJECTS

For further details on Lincoln's new, high-current-density "Manual Lincolnweld," write to Dept. 185,

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NEWS

Tax Write-Off Plan Suspended for Review

A 60-day suspension for a general review and tightening of controls has been ordered for the government's rapid tax write-off plan for defense plant extension. Defense Mobilizer Charles E. Wilson ordered a thorough examination of the plant, to determine how much of the tax concessions to defense plants are paid for through higher prices for the things it purchases.

The plan allowed defense plants to write off the costs for tax purposes over 5 years rather than the customary 20 to 25 years. This reduces the tax liability of the companies for those years.

Military Deferment Aid For Oil and Gas Industry

Conditions under which the Petroleum Administration for Defense will help try to get deferment from or a delay in a call to active military duty for key personnel in the petroleum and gas industry have been announced by Deputy Petroleum Administrator Bruce K. Brown.

Brown emphasized that PAD will not intervene in any case until all normal procedures for appeal from an induction order or a recall to active duty from the reserves have been exhausted.

PAD also will refuse to intervene, Brown said, in the following cases:

1. Those of graduates of the service academies or recent graduates of Reserve Officers Training Corps programs.

2. Those involving only hardship to the individuals concerned.

3. Those in which the person to be deferred does not know of and approve the application for special consideration.

In all other cases, Brown said, rigid standards will be used by PAD in determining whether or not to support an employer's request for special consideration.

Explaining details of the policy statement, Brown said the person for whom deferment or delay is sought must be:

1. A key managerial or executive official or one in an occupation included in the List of Critical Occupations published by the Department of Labor or in an occupation equally critical in essential petroleum industry operations.

2. Engaged full-time in an activity included in the List of Essential Activities published by the Department of Commerce or in the production of oil field equipment and machinery, tetraethyl lead, catalyst, or similar items for which PAD has responsibility.

3. Irreplaceable without material loss of effectiveness in the activity in which he is engaged.

4. Adequately trained for the work in his occupation.

Requests for assistance in obtaining delay or deferment in cases meeting these requirements should be addressed to:

Manpower Division,
Petroleum Administration for Defense,
Washington 25, D. C.

PAD establishment of a policy on assistance for deferments was requested by the National Petroleum Council. N.P.C. spokesmen said they were chiefly concerned about the possible calling up of technical and professional men engaged in oil-exploration, refining, research, and development work.

Australian Shale Is Described in Report

How Australia has been producing motor gasoline and allied products on a commercial scale from native oil shale is described in a Bureau of Mines report released by Oscar L. Chapman, Secretary of the Interior.

Two Bureau technologists — A. J. Kraemer, a refinery engineer on the Washington headquarters staff, and H. M. Thorne, chief of the Oil-Shale Research Branch, Region 4, Laramie, Wyoming—visited the plant and mine of the National Oil Proprietary, Ltd., at Glen Davis, New South Wales, in September, 1947, in connection with the oil shale phase of the Bureau's synthetic liquid fuels program. The report is based upon their observations supplemented by laboratory tests of Australian oil shale and shale oil.

A free copy of Report of Investigations 4796, "Oil-Shale Operations in New South Wales, Australia," can be obtained from the Bureau of Mines, Publications Distribution Section, 4800 Forbes Street, Pittsburgh 13, Pennsylvania.

South Texas to Honor Oil and Gas Industry

The Alice, Texas, Chamber of Commerce will stage a celebration honoring the oil and gas industry of South Texas on December 3 and 4, according to an announcement following official action by the board of directors.

The celebration, which will be limited to the oil and gas industry, will encompass the entire South Texas area and will honor those men who have contributed most to the development of this important phase of the economy of the area. The board chose the name "South Texas Blowout."

There will be an opening parade, barbecue, oil field equipment show, a dinner honoring those who will be guests for the event, the crowning of Queen Petrolia I, and an outdoor pageant on a 100-ft stage, depicting the growth of the area and the development of the oil industry. Chambers of Commerce all over the area are being invited to participate and are being asked to send the committee the names of those men in their areas who have contributed the most to the development of the oil and gas industry in their respective areas.

World Oil Output Up

World production of crude petroleum in 1950 totaled 3,796,000,000 bbl (10,400,000 bbl daily), an increase of 392,000,000 bbl or 11.5 per cent over 1949. The largest production increases were in the United States, where production gained 129,900,000 bbl, the Middle East, where the gain was also 129,900,000 bbl, and Venezuela, where production increased 64,500,000 bbl over 1949.

North American crude oil production increased 149,000,000 bbl with production increases in the United States of 7.1 per cent, Mexico 18.9 per cent, and Canada 36.4 per cent. South America, including the Caribbean, increased crude production 70,600,000 bbl due principally to record Venezuelan output. Colombian production gained 14.6 per cent with the installation of new pumping facilities on the Andian pipe line. The Western Hemisphere's share of world crude production declined from 73.4 per cent in 1949 to 71.6 per cent in 1950, even though all the major producing countries in the hemisphere increased production over 1949.

In Europe, Western Germany increased crude production almost 2,000,000 bbl, and Netherlands production increased 583,000 bbl. France more than doubled 1949 production with the development of the Lacq field. Eastern European production (excluding the USSR) is estimated to have decreased due to reduced output in Rumania. The USSR is estimated to have increased 1950 production 11.6 per cent over 1949.

Oil Companies Report Net Income Rise

Most of the major oil companies have reported incomes for the first six months of this year far exceeding these for the first six months of last year. Most significant in the semi-annual reports was the fact that on a comparison basis, increase of sales was considerably higher than the increase of incomes. Reason for this was given as higher operating costs and higher federal taxes.

Iran, Britain Fail To Make Settlement

Although talks are continuing between Britain and Iran, no satisfactory settlement has been reached. The Iranians are insisting on two laws—turning over 75 per cent of the Anglo-Iranian Oil Company properties to the Iranian government, and impounding 25 per cent against possible compensation claims.

The British proposed recognition of nationalization and the authority of the National Iranian Oil Company, by turning over AIOC assets in Iran, subject to compensation arrangements.

The Anglo-Iranian company would then set up a separate purchasing organization to buy Iranian oil and refinery products under a 25-year contract. This organization would distribute and sell Iranian oil throughout the world.

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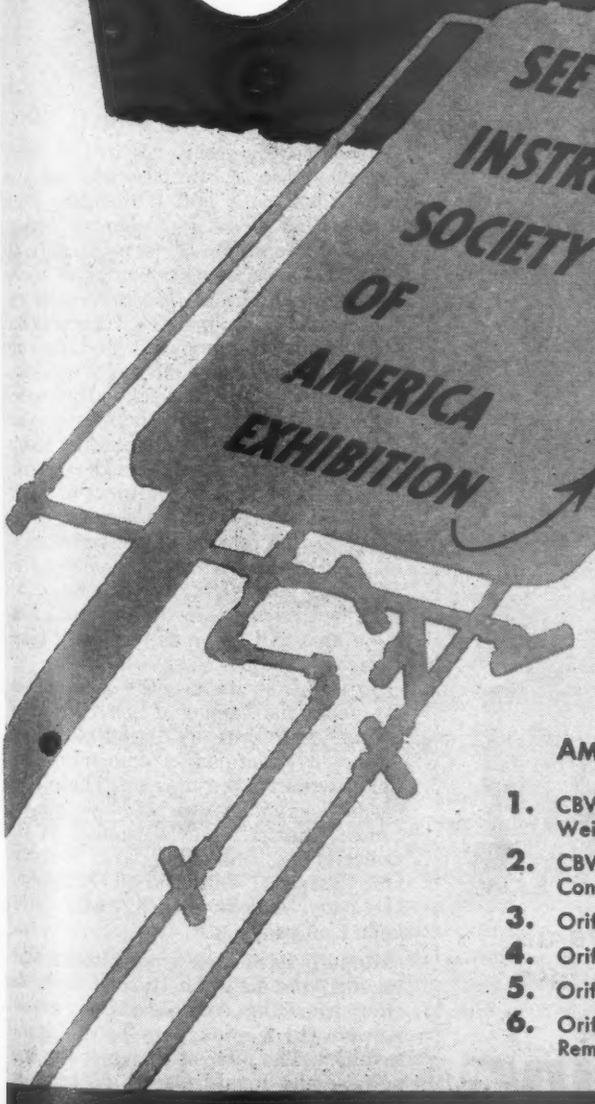

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A training course covering the six emergency measures necessary to make an injured person comfortable until he can receive the attention of a physician has been prepared by the Department of Technical Services of the American Petroleum Institute. Details of the course are contained in a First-Aid and Safety-Training Guide, which is now being made available to the oil industry and other interested purchasers. The Guide also outlines the petroleum industry's program for the safety of individual employees, as well as the personal protective equipment available and its functions.

NSPE Conference Board

A public relations program to be conducted as a research project on current engineering-management problems, has been launched by the National Society of Professional Engineers. The program is designed to establish a "clearing-house" for the two-way exchange of information and ideas, and is to be conducted with the guidance of an NSPE advisory group, the Professional Engineers Conference Board for Industry. In operation, this Board, working with the Society, will screen and advise on the contents of the topics selected for research survey questionnaires dealing with subjects of current major interests.

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PAD Limits Gas Users In Fifteen States

Fear of a gas fuel shortage this winter has prompted the Petroleum Administration for Defense to order restriction of use of natural gas in 15 heavily-industrialized eastern states. The order requires that PAD authorization be obtained before any new big-volume customers be taken in. Utilities are prohibited from taking on more than one per cent as many new residential customers as they are now serving.

Reason for shortage is lack of pipe lines to carry the gas, brought about by the steel shortage.

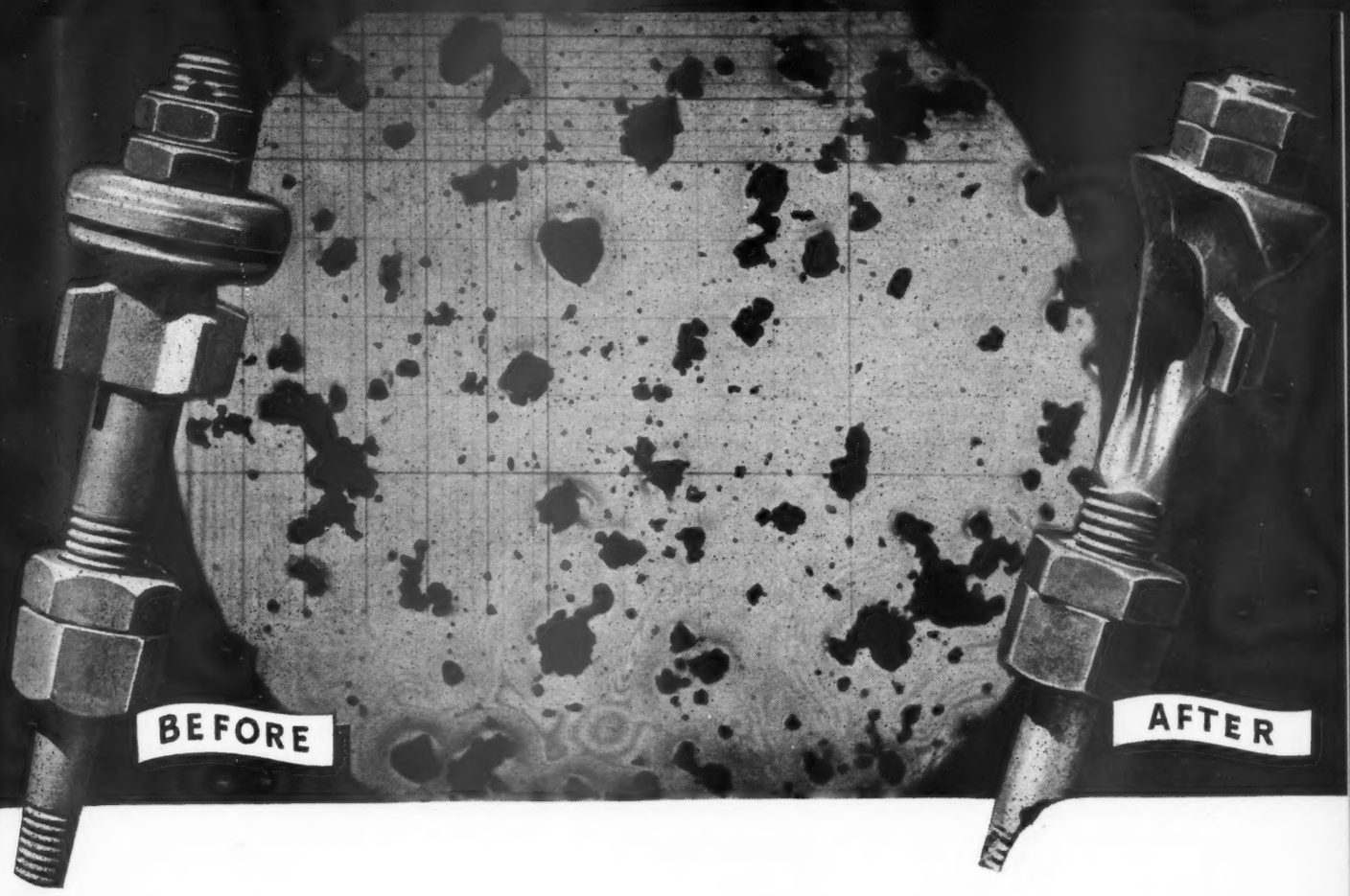
States affected by this measure are: District of Columbia, Connecticut, Delaware, Kentucky (but only those parts of Kentucky served with gas supplied by a subsidiary of the Columbia Gas System, Inc., or by Louisville Gas and Electric Company), Maryland, Massachusetts, Michigan, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Virginia, West Virginia, and Wisconsin.

Nationalization of Oil Has Far-Reaching Effect

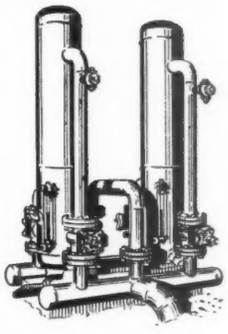
Iran has apparently lighted the way for a number of countries who wish to follow her path and nationalize their own oil industries. In Colombia nationalization went into effect peaceably on August 25. An agreement has been reached whereby all the properties explored and developed by International Petroleum Company, Ltd. and its subsidiary, the International Petroleum (Colombia) Ltd. automatically passed into control of the Colombian government. International will continue to operate the properties through its subsidiary. L. P. Maier, president of International Petroleum Company, announced that outside of the presence of officials of the Empresa Colombiqna de Petroleos, the government-owned oil firm, developments in the Barranca Bermeja area will go on as they have since 1921.

In Rangoon, Burma oil workers meeting under the banner of the All-Burma-Burmah Oil Company Staff Union, have approved a resolution demanding nationalization of Burmese oil. Three British oil companies own and operate the central Burma oil fields jointly as Oil Concessions, Ltd. They are: Burmah Oil Company, Indo-Burma Petroleum Company, and British Burmah Petroleum Company.

Reports have come from Kuwait, stating that the sheik has turned down an offer from the Anglo-American-owned Kuwait Oil Company to boost his oil royalties. The offer of the company was to raise the royalties from 63 cents to $3.50 a ton. Gulf Oil Corporation, which owns 50 per cent interest in Kuwait Oil Company reported, however, that it had not received any information showing the shiek's attitude, and that the dispatch from Kuwait did not correctly reflect his ideas.



The Toll of "MICRONIC BOMBING"



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EVER SEE A MICRON?

Probably not, since it measures only .000039 in.— the width of one of the fine lines shown above.

In this photomicrograph, gas line dust particles of micronic proportions are visible only because they have been magnified 40 times! They were photographed from an actual sample representative of dust that caused the damage to the valve regulator stem at right. In this instance dust not only eroded the valve stem, but blasted a hole through the body . . . escaping gas was ignited by a spark, setting the regulator building afire and cutting off the town's gas supply! Such dramatic exhibitions of dust's damage may be few and far between but—dirty gas *always* increases transportation expense, seriously affects accuracy of metering and pressure regulation and is responsible for increased service calls and costs.

GAS EQUIPMENT DEPARTMENT
BLAW-KNOX DIVISION OF BLAW-KNOX COMPANY
2126 Farmers Bank Building, Pittsburgh 22, Pa.
Offices in Principal Cities

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OPS Issues New Ceiling Price Regulations

Firms covered by the general manufacturers' order and related manufacturing regulations must figure their new ceilings under the provisions of these orders as they existed before the new Defense Production Act became effective, on August 1, it was emphasized by Office of Price Stabilization officials in a statement issued recently.

Some confusion has arisen over this point, they said, because of the so-called Capehart amendment to the Defense Production Act, providing that ceilings on materials and services must reflect increases or decreases in costs, including overhead, up to July 26.

It has come to the attention of OPS officials that some manufacturers are under the impression that they may calculate their ceilings on the basis of the Capehart amendment rather than the formulas spelled out in the manufacturing orders.

This impression, they said, is false. The manufacturing regulations, having been issued before the enactment of the amendments to the Defense Production Act, remain in effect. These regulations do not provide for increase in overhead.

The Capehart amendment, however, provides that "upon application and a proper showing of . . . prices and costs," the OPS shall adjust ceilings to reflect changes in costs, including overhead, up to July 26, 1951, a somewhat later cut-off date than used in the manufacturing regulations. OPS is now studying methods by which this new requirement can be placed in regulatory form.

OPS officials said that undoubtedly the provisions of the Capehart amendment will give many manufacturers higher ceiling prices upon application to the agency. On the other hand, they pointed out, some manufacturers will not be entitled to any increases because in some fields costs on July 26 were no higher than on earlier cut-off dates used in the manufacturing regulations. (Cut-off date for most materials was December 31, 1951, and for labor March 15.)

So far as overhead costs are concerned, they continued, many of them have decreased between pre-Korea and the present time because of increased volume.

Officials said the situation may be summarized as follows:

1. Manufacturers under the general manufacturers' order (CPR 22), and the machinery order (CPR 30) must file their public forms under these regulations on or before August 13, if they have not already done so.

2. Ceilings under CPR 22 and CPR 30 and related manufacturing orders must be computed on the basis of the formulas in the regulations.

3. Any rollbacks called for in these regulations must be placed into effect no later than August 13; except in the case of the apparel order, where the deadline is August 15.

4. Manufacturers filing forms under CPR 22 and CPR 30 on August 13 would have to rollback prices under these regulations on that day, but would have to wait until 15 days after the forms have been received by OPS before increasing any prices above the levels of the General Ceiling Price Regulation. After that period they may increase the prices, if they have not been disallowed by OPS or further information requested.

5. Manufacturers who have already waited 15 days and are legally entitled to place increases under CPR 22 and CPR 30 into effect before August 13, must also place any rollbacks into effect at the same time.

OPS Sets Ceiling Price East Texas Crude Oil

The Office of Price Stabilization has set a specific ceiling price of $2.65 per barrel at the receiving tank for crude petroleum produced in the East Texas oil field. The announcement came from William J. Speck, Dallas district OPS director.

He said the order covers the East Texas field, as designated by the Texas Railroad Commission. Included are the counties of Upshur, Gregg, Rusk, Smith, and Cherokee.

The ceiling price was established under Supplementary Regulation No. 1 under Section 8 of Ceiling Price Regulation No. 32. It is effective immediately.

Speck said this new order replaces pricing under the old formula and places a more easily administered dollars-and-cents price on production from the East Texas field. The $2.65 price is now applicable to roughly 96 per cent of the production in this major oil field, according to information received by Director of Price Stabilization Michael V. DiSalle, Speck said.

The remaining 4 per cent of the crude petroleum produced in the East Texas field may continue to be sold at existing slightly higher prices under Section 16 of CPR-32, which authorizes continuation of contracts in effect prior to January 25, 1951.

OIIC Booklet Describes American Oil Industry

An attractive full-color booklet that describes the workings of the American petroleum industry in easy-to-understand language, has been produced by the Oil Industry Information Committee for distribution by oil companies during Oil Progress Week, October 14-20. The booklet is entitled "Oil Serves You." Sixteen pages in length, it tells the story behind the story—the work that must be done, and the amazing total of men and materials employed in moving oil from subterranean depths to America's 150,000,000 consumers.

DPA Cuts Steel Supply In Fourth Quarter Period

Numerous complaints have been voiced in Washington about the cutback in steel allocations in the fourth quarter.

Deputy Petroleum Administrator for Defense, Bruce K. Brown has announced that PAD received 2469 requests for authorization but only 1349 were granted. He reported that 1120 had to be turned down. New forms for requests for the first quarter of 1952, have been issued, with the deadline set for this month. Brown announced that despite shortage of steel the oil and gas industries are meeting PAD's expansion goal.

Oscar L. Chapman, Secretary of the Interior, recently returned from Mexico, has requested additional steel for that country in exchange for its petroleum products. Emergency measures are also being taken in Canada in an attempt to make the New World self-sustaining in the event of war or loss of oil from Iran.

On the other side of the world, the European steel industry is reported to be booming. French production hit an all-time high in June, putting out a total of 832,000 tons, exceeding the monthly average in the peak year, 1939, by 111,000 tons. Counting the Saar output, June production was more than 1,000,000 tons.

But French consumers and producers are complaining that the internal price fixed by the government is too low, and users declare exports, which have been around 300,000 tons monthly, are excessive. The shortage of coke is acute in Germany and France. German steel output which also reached a new record in June, was helped by American coal imported under a condition that 80 per cent of the steel produced therefrom be exported to the U. S.

French authorities, who report that the development of Lorraine iron ore production and construction of vast coke ovens continues, claim that Germans are exaggerating the scarcity of scrap and coke in that country.

Phillips to Aid Employees Sustaining Flood Losses

A plan to assist in the rehabilitation of all Phillips employees who suffered damage to their homes or personal property in the recent floods in the Kansas City area has been announced by K. S. Adams, chairman, and Paul Endacott, president, of Phillips Petroleum Company. There are approximately 1400 Phillips employees in the Kansas City area.

Under terms of the plan Phillips will contribute money to the extent of half of an employees damage up to a loss of $4000 and provide a non-interest bearing loan for additional funds to replace the loss. The loans may be repaid by salary deductions over a period of three years. Applications for aid may be submitted to the employee's local manager.

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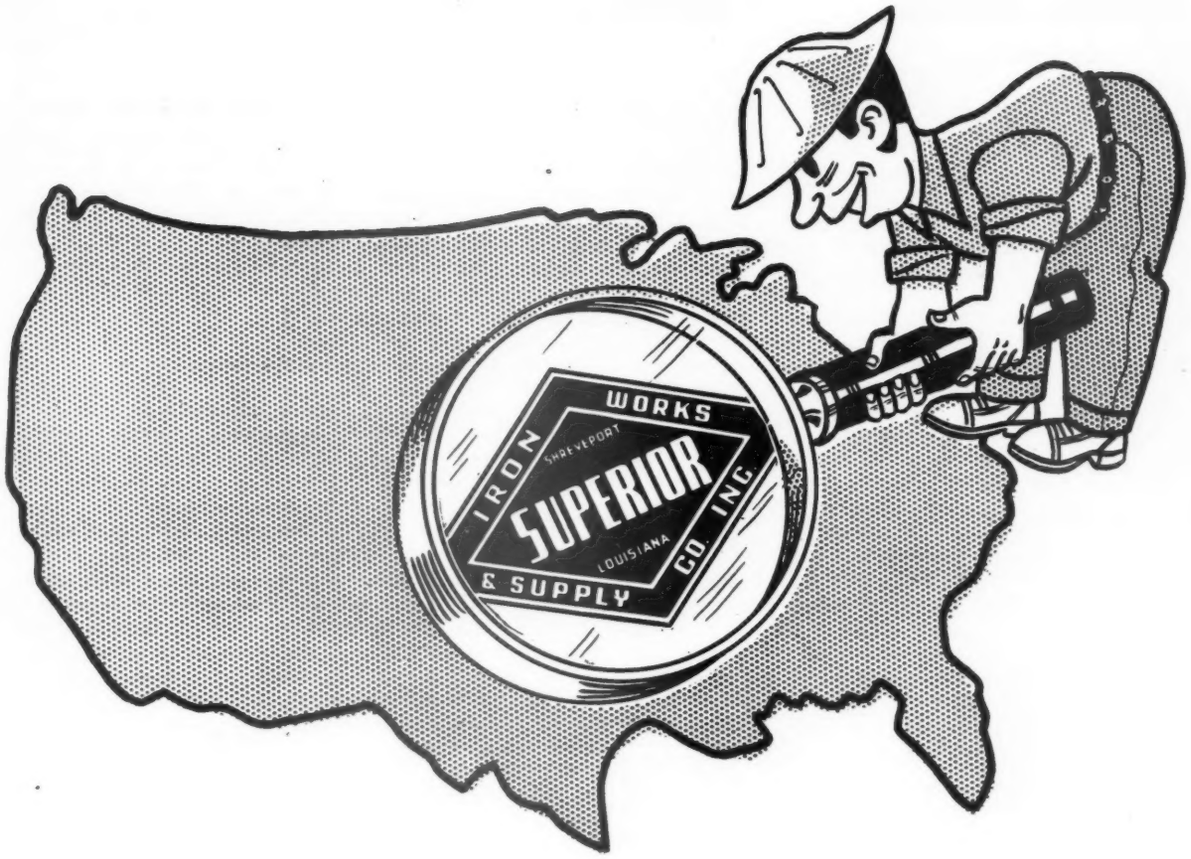

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Frank Pace, Jr.

Oscar L. Champman

Chapman, Pace to Speak Before Oil, Gas Meeting

Secretary of the Interior Oscar L. Chapman and Secretary of the Army, Frank Pace, Jr., have accepted invitations to address the 32nd annual meeting of the Texas Mid-Continent Oil and Gas Association in Beaumont, Texas, October 8-9.

Secretary Chapman will be the principal speaker October 9 at the dedication of the new Lucas engineering building at Lamar State College of Technology, named for the discoverer of the famous Spindletop well.

Secretary Pace, who is the youngest member of the top administrative echelon in Washington, will be one of the principal speakers. Dedication of the Lucas engineering building will highlight the final day program of the meeting and will climax the 50th anniversary observance of the Spindletop discovery in Beaumont, Texas.

Receipts from Special Federal Petroleum Taxes

	Gasoline		Lubricating oil		Pipe lines	
	1951	1950	1951	1950	1951	1950
January	$43,699,572.79	$ 42,347,299.51	$10,835,432.45	$ 4,848,993.53	$ 1,919,111.54	$ 1,287,268.45
February	47,826,608.86	37,654,711.76	6,191,756.40	5,709,664.36	2,020,304.54	1,872,019.05
March	37,593,597.07	53,983,521.99	4,865,218.09	7,860,832.93	2,180,417.40	1,467,100.46
April	45,400,950.52	28,879,125.63	6,277,517.87	3,417,287.87	2,025,936.53	1,897,800.11
May	45,329,320.29	45,336,535.21	5,881,711.33	6,252,005.07	2,599,868.02	1,533,952.72
June	52,379,412.46	46,430,029.93	10,518,841.91	10,991,595.64	1,841,503.49	1,458,128.56
Sub-total	272,229,461.99	254,631,224.03	44,570,478.05	39,080,379.40	12,587,141.52	9,516,269.35
Total for year	.....	$551,449,723.02	.....	$91,747,997.24	.....	$21,875,071.41

NOTE: As of July 1, 1940, tax rate on gasoline increased from 1c to 1½c per gallon; on pipe lines from 4% to 4½% of transportation charge. Tax on lubricating oil increased from 4c to 4½c per gallon as of July 1, 1940, and from 4½c to 6c as of November 1,1942.

SOURCE: Treasury Department, Bureau of Internal Revenue.

Steel Scrap Drive

In a company-wide salvage campaign throughout its oil producing leases in 10 states, at 3 refineries, and half a dozen field gasoline plants, Sunray Oil Corporation has collected and returned to the scrap salvage market more than 820 tons (approximately 1,640,000 lb) of iron, steel, and other metal scrap now vitally needed by the country's defense and business industries.

Sunday's campaign was inaugurated in cooperation with the National Production Authority's request for users of steel products to help the steel industry secure more scrap.

Houston Nomads Meet

One of the happiest, funniest, and most joyful events of the year was celebrated by the Houston Chapter of Nomads recently, at the Texaco Country Club near Houston. Highlights were the golf tournament, barbecue, and initiation of nine new members.

Foursomes of members and guests teed off at 12 noon. Nineteen hole prizes were awarded by Head Judge Nomad Jack Barnes for the man in the foursome having the least hair on his head, having the loudest socks, the least putts on No. 18, chipping closest to the pin, etc. Scores were adjusted through Shawnee Handicaps with Nomad Wayne Rives and Guest T. S. Blanton winning top honors. Nomad Ed Gearke and Guest Clyde Martin took bottom honors. Low gross prizes were awarded Nomad George O'Leary and Guest Billy King.

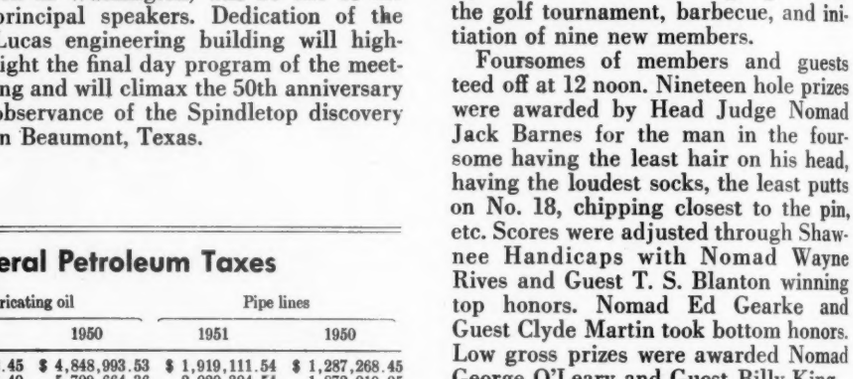
Following the tournament refreshments, and a delicious barbecue, the initiations were served by Nomads Larry Kelley, H. Ben Young, Harry E. Estes, and Fred Christanelli. After reading the qualifications and introducing each applicant, the nine new members went through the mystical rites of Nomads and were accepted.

Mass Spectrometers

A completely automatic amplifying and recording system for the analysis of gaseous mixtures or isotope ratio determinations by a mass spectrometer, was reported at the American Institute of Electrical Engineers Pacific meeting by Paul S. Goodwin and Robert L. Sink, of Consolidated Engineering Corp.

"The mass spectrum of a complex gaseous mixture can be used to obtain the quantitative and qualitative composition of the mixture with the aid of calibration spectra of the pure component constituents," the Institute was told.

The authors said: "In studies using stable isotopes as 'tagged molecules' in a chemical or biochemical process, the mass spectrometer has proved to be an accurate and convenient method of measuring the results of such experiments. Simultaneous measurement of the ion current of the molecule and isotope is advantageous, as factors that affect the ion currents equally can be cancelled in a rationing process."



Houston Nomads initiate nine new members: Standing, left to right, are B. H. Pickard, Tom Herndon, J. D. Thornton, A. C. Oden, J. T. Tucker, Ed L. Hannon, Jr., Gail O. Carroll, R. J. Munn, and J. A. Tennant, Jr. The initiators kneeling are H. Ben Young, Larry J. Kelley, Harry E. Estes, and Fred Christanelli. The Nomad meeting was held at the Texaco Country Club near Houston. In addition to the initiation services, a golf tournament and barbecue was held for the members and guests. Nineteen hole prizes were awarded various entrants in the golf tourney.

PERSONALS

L. A. C. Bartlett and **W. A. H. May,** have been appointed to the board of George Kent, Ltd., London and Luton.

Bartlett has been with George Kent, Ltd., for 25 years, entering the firm as an apprentice. After service in most of the departments of the firm he was, in 1939, placed in charge of research on automatic control systems.

May joined George Kent, Ltd., in 1938 as personnel manager. He served for nearly seven years in the Royal Engineers, returning to the firm in 1946 and is now administration manager.

M. B. Garber, director of sales of The Thew Shovel Company, Lorain, Ohio, has been named a director of the construction machinery division of The National Production Authority. He has been a consultant for the past 6 months on an on-call basis for NPA. Garber headed the construction machinery division of the WPB during World War II.

Miles Heberer was recently appointed directory of study tours for the World Metallurgical Congress to be held in Detroit, Michigan, October 14 to 19. American Society for Metals is sponsor of the international meeting.

In his new appointment, Heberer will be in charge of transportation, housing, and special events for more than 250 top-ranking metal scientists who will arrive in New York from 20 of the free nations of the world on September 13 for a 4 weeks series of study tours.

Kingsley W. Given, professor of speech, Kansas State College, Manhattan, Kansas, now on leave, has been named executive assistant for the Congress to **William H. Eisenman,** secretary of ASM. He will work with Eisenman in arranging details for the Congress.

Jack Francis Dougherty was recently elected vice president of Empire Trust Company's oil and natural gas department. He was formerly vice president of DeGolyer and MacNaughton, Dallas. From 1942 to 1945 he was associated with Phillips Petroleum Company at Amarillo, Texas.

C. A. P. Southwell, managing director of Kuwait Oil Company, Ltd., has been reelected president of the Institute of Petroleum, London, England, for 1951-52. A member of the Institute since 1928, Southwell was elected to the council in 1936, made a vice president in 1948, and has been a member of various council committees.

Dr. E. B. Evans has been elected a vice president of the institute. Evans is chief chemist of Esso Development Company, Ltd., and was first elected to the council in 1939. He was named vice president for 1948 and 1950.

Maynard I. Landa has been appointed associate petroleum economics coordinator, for Cities Service Company. Landa, an engineering graduate of Texas A. and M., joined Cities Service as a junior engineer in 1919. On completion of the company's engineer training course, he was assigned to the oil production department as an engineer, and later was actively engaged in oil operations in Oklahoma, Arkansas, and Texas. In 1923 he became assistant to the manager of oil production at the company headquarters for operations in the Mid-Continent field in Bartlesville, Oklahoma, and in 1925 he was transferred to the New York headquarters office to make special analyses studies of petroleum operations. In 1941 he became manager of the petroleum economics and statistics department handling these studies.

Hugh H. Lamberth has joined the Petroleum Administration for Defense in Washington, D. C. as chief of the gas-materials branch. He was formerly associated with Refinery Maintenance Company.

A. G. McNeese, Jr. has joined the administrative staff of Houston Oil Company of Texas and its subsidiaries as administrative assistant to Harold Decker, president. McNeese was formerly with G. H. McCarthy interests. A university of Texas graduate, he served variously as general counsel, vice president, and director of several of the McCarthy companies.

M. W. Marshall, has joined the Texas Railroad Commission at San Angelo, Texas, as district petroleum engineer. Marshall was formerly petroleum engineer for R. V. Fitting, Jr., at Midland, Texas.

J. Lee Johnson has been named president of the First National Bank of Fort Worth, Texas. He succeeds **M. A. Fuller,** who has been elected chairman of the board. Johnson a well-known southwestern oil man, has substantial interests in 749 producing wells on the Mallet Lands in the Lubbock, Texas area and 370 producing wells on the ranch of the Johnson estate in Ector County, Texas.

Harry William McHose has joined the staff of the Department of Information of the American Petroleum Institute in New York as editorial director. McHose succeeded **Joseph H. Mader,** who resigned recently. He will be in direct charge of the preparation of the many informational booklets, leaflets, pamphlets, and other materials produced in the headquarters office of the Oil Industry Information Committee.

Born in Decatur, Illinois, McHose was educated at College of Idaho and Columbia University School of Journalism. Just prior to joining the American Petroleum Institute, he operated his own public relations firm in New York.

Earl A. Brown

Earl A. Brown has been appointed as general counsel of Magnolia Petroleum Company and Magnolia Pipe Line Company. He succeeds the late Walace Hawkins. Brown was graduated from the Law School at the University of Texas in 1914 and after practicing law for three years in Ennis and Waxahachie, he moved to Tulsa, Oklahoma, where he practiced until 1920. In 1936 he joined Magnolia's legal staff at Oklahoma City. After three years there, he was transferred to Magnolia's general offices in Dallas as assistant general counsel.

Jack Baumel, chief engineer of the Texas Railroad Commission's Oil and Gas Division, has submitted his resignation effective January 1. He has announced that he will return to Venezuela as technical adviser to the government.

Baumel has been with the Railroad Commission for more than 15 years, and has served as chief engineer since 1945. He was a director of production from 1942 until 1945.

William H. Martin has been named president of The Oil Corporation at Corpus Christi, Texas. He was formerly general superintendent for Heyser and Heard Oil Company at Midland, Texas.

James T. Ross, formerly district superintendent at Longview, Texas for United Gas Corporation, was recently transferred to Shreveport, Louisiana, as distribution training specialist.

Another United Gas employee, **Paul T. Priesmeyer,** engineer at New Braunfels, Texas, has been transferred to Houston, Texas.

Loring E. Heckman, who was an engineer with Columbia Gas System companies from 1928 until 1942, has rejoined the system as vice president of Columbia Gas System Service Corporation.

Heckman was appointed senior analyst in the Office of Petroleum Coordinator (later Petroleum Administrator for War) and was subsequently promoted to the chief of the natural gas section. He became a natural-gas engineer in the gas certificates division of the Federal Power Commission, later becoming chief of that division.

▸ **J. J. Dorgan, Jr.** has been granted a leave of absence from Continental Oil Company at Houston, Texas to join the program division of the Petroleum Administration for Defense in Washington, D. C. Dorgan was in the coordinating and planning department of Continental.

▸ **John B. Glenn** will represent Republic National Bank in Mexico with offices at Isabel la Catolica No. 45, in Mexico City, for Republic National Bank of Dallas, Texas. He will work closely with Mexican banks having business in Texas and the United States and will also render service to customers and friends of the bank during business or traveling on pleasure in that country.

Glenn is president of the John B. Glenn, S.A., and the Mexican Chamber of Commerce. He is well known in Mexico, having received the Decoration of the Mexican Aztec Eagle, the highest honor ever given to a foreigner, for services of good will between Mexico and the United States for a period of more than 30 years.

Glenn holds directorships in the New York Board of Trade and Inter-American Commercial Arbitration Commission. He is also a member of the executive committee, Pan American Society. Increasing business between the U. S. and Mexico prompted the appointment.

▸ **Major General Thomas F. Farrell,** deputy administrator of the Defense Production Administration, has been appointed assistant general manager for manufacturing, Atomic Energy Commission. General Farrell is on military leave from his post as Chairman of the New York Housing Authority, and is on military assignment to the AEC from the Army. A graduate of Rensselaer Polytechnical Institute, Farrell began his career with work on the Panama Canal in 1913.

General Farrell's AEC post is newly created. His responsibilities include the management of all atomic energy work concerned with getting supplies of uranium and other raw materials, the processing of feed materials for the production plants at Oak Ridge, Savannah River, Hanford, and Paducah, the operation of the production plants, and the construction of new production facilities.

▸ **William J. Warren** has joined the staff of Shell Development Company and has been assigned to the associate directors' staff. He received his Ph.D. in Electrical Engineering at the University of Illinois in 1936, and comes from the University of Santa Clara where he has been professor of electrical engineering and part-time consultant for industrial firms since 1941.

DEATHS

▸ **Earle S. Porter,** vice president and director of Amerada Petroleum Corporation, died August 14 following an operation. He had been with Amerada for 30 years, and had been a vice president since 1938. He became a director in 1948.

Porter joined Amerada in 1921, becoming assistant to the vice president two years later. He was named manager of production in 1927. Before joining Amerada, Porter was assistant professor of chemistry at the University of Oklahoma and assistant director of the research laboratory of I. I. du Pont de Nemours and Company, Inc.

▸ **Walace E. Hawkins,** vice president and general counsel of the Magnolia Petroleum Company died of gunshot wounds received in his home August 6. His son, John Michael, is being held in connection with the shooting.

Hawkins, former Assistant Attorney General of Texas, received the Texas Mid-Continent Oil and Gas Association's distinguished service award in 1947. A graduate of Texas University Law School, he joined the legal department of Magnolia Petroleum and Magnolia Pipeline Companies in 1925, becoming general counsel in 1939. He was an executive member of the Texas Mid-Continent Oil and Gas Association and the general Mid-Continent Oil and Gas Association.

Hawkins was a leader in the American Bar Association's mining law section, which is distributing a legal history of the conservation of oil and gas. Hawkins was deeply concerned in conservation of petroleum, and wrote the introduction of the legal history.

▸ **James M. Floyd** of Dallas, Texas Lone Star Gas Company advertising director, died at his home on August 9. Floyd was a familiar figure at gas industry conventions and at the time of his death held important assignments in both the American Gas Association and Southern Gas Association advertising and promotion programs. He was serving his fourth year as a member of the A.G.A. publicity and advertising committee and his second year as chairman of the film committee the SGA, which was in the process of making a script for a motion picture on the gas industry.

He became a member of Lone Star's legal staff and was assigned to its Fort Worth division in 1937. Ten years later he was appointed advertising director. He was in charge of advertising copy preparation for more than 250 newspapers and magazines on the Lone Star system and for numerous radio stations, display material, and the Lone Star magazine, Blue Blaze, which is circulated to the company's 6,000 employees. He also directed all newspaper, radio and magazine publicity for the company and a myriad of other affairs related to publicity and gas industry promotion. At the time of his death he was a lieutenant commander in the Naval Reserve.

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LAUGH with BARNEY

Sales Manager: What's this big item on your expense account?

Traveling Salesman: Oh, that's my hotel bill.

Sales Manager: Well, don't buy any more hotels.

' ' '

A woman telephoned her bank to arrange for the disposal of a thousand-dollar bond. "Is the bond for redemption or conversion?" a clerk inquired. There was a long pause, then the woman asked: "Am I talking to the First National Bank or the First Baptist Church?"

' ' '

The young lover was obviously reeling out a heavy line trying to impress the beautiful young girl at his side. "Those soft lovely hands," he whispered. "Your warm lips. And those beautiful eyes! Where did you get those eyes?"

The girl answered unimpressed, "They came with my head."

' ' '

"Hey, what are you doing?" yelled the foreman.

"I'm just sharpening a pencil," answered the bricklayer.

"Well, don't let anybody see you. That's a carpenter's job, you know."

One of the members of the bridge club who had been to a swanky party was making a detailed report to her friends.

"And how," one asked, "did young Mrs. Jones look?"

"Well," was the woman's reply, "you know her habit of always complaining to everybody about how little she has to wear?"

"Well, this was the night she was wearing it!"

' ' '

During a conversation with an old friend he hadn't seen for some time, a Florida farmer was asked how he had been sleeping.

"I sleep good nights," he said, "and I sleep pretty good mornings, but afternoons I just seem to twist and turn."

' ' '

A Scotchman, inviting a friend to his wedding anniversary, explained how to find his apartment. "Come to the seventh floor," he said, "and where you see the letter 'D' on the door, push the button with your elbow, and when door opens put your foot against it.

"Why do I have to use my elbow and my foot?" asked the friend.

"Well, for Heaven's sake! You're not coming emptyhanded, are you?"

The farmer's barn had burned down and the agent for the insurance company explained the policy that covered the structure and told him that his firm would build another barn of similar size instead of paying the claim in cash.

The farmer was furious. "If that's the way you do business," he exploded, "you can cancel the insurance on my wife."

' ' '

It was the morning after a riotous party. Maggie, who was always a judicious celebrator, managed to rise from her bed in a fairly good condition, but Jerry, her husband, was in an awful state. He sat holding his head and groaning.

"Jerry," his cautious wife admonished, "I warned you last night. If you hadn't drunk so much, you wouldn't feel so horrible this morning."

"Drink had nothing to do with it," the afflicted man moaned. "I went to bed feeling wonderful and wake up feeling awful—it was the sleep that did it."

' ' '

A long, beautiful car drew up to the curb where Cutie Cathead was waiting for the bus. A man stuck his head out and said, "Hello, I'm driving south."

"How wonderful," replied Cutie. "Bring me back an orange."

' ' '

"Madam, I'm representing the Goat Mountain Wool Company — would you be interested in some coarse yarns?"

"Sure, go ahead, let's hear a couple."

' ' '

For every woman who yearns for that school girl complexion there's a man who longs for that school boy digestion.

' ' '

Little Woman: They have no car, no television set, no piano. I can't imagine what they do have!

Spouse: A bank account, perhaps?

' ' '

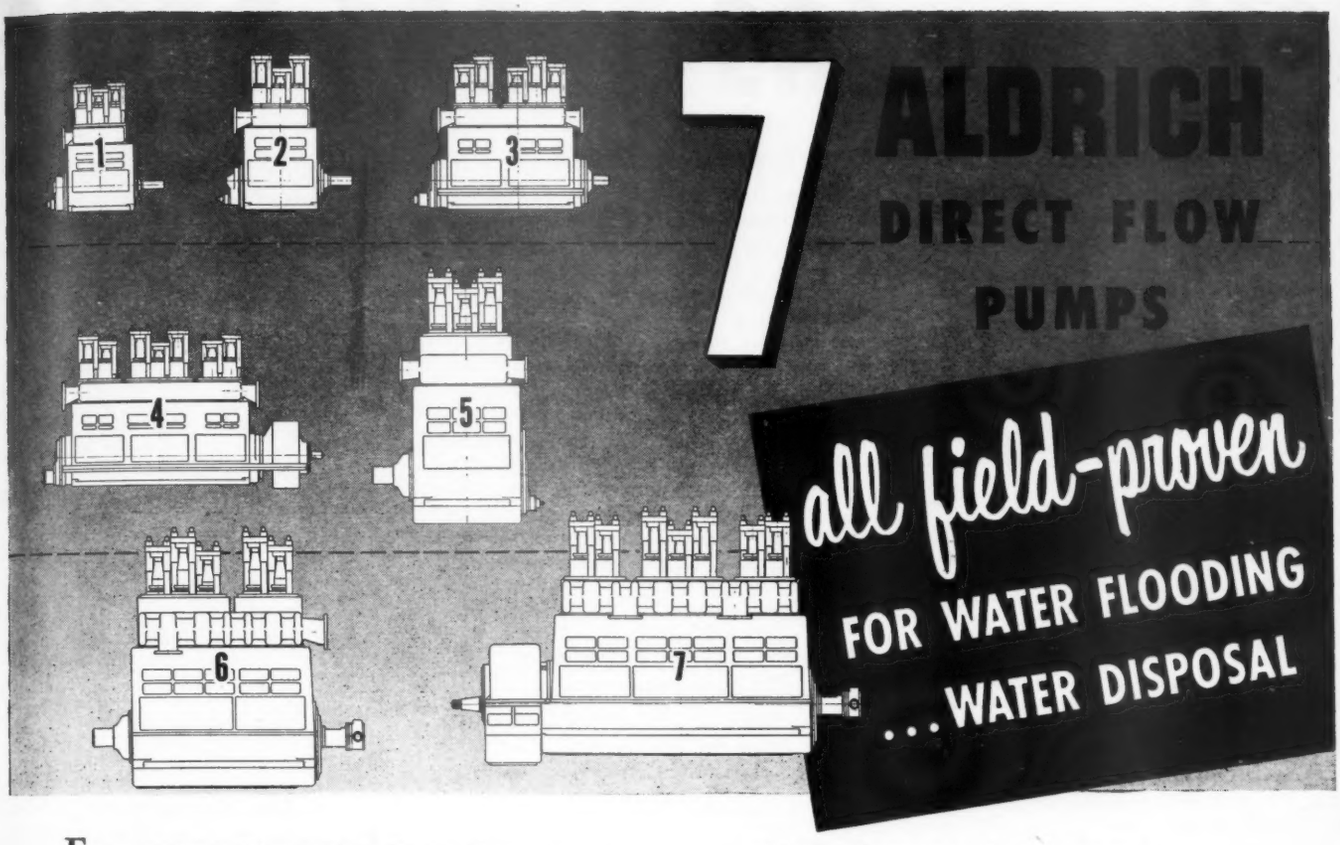
Hiking back to civilization after their car broke down, the party of hunters stopped at a lonely cabin to ask for shelter and a meal. Somewhat ungraciously the woman of the house agreed, and for supper set a platter of pork chops and potatoes before them. One of the men complimented her on the fine meat.

"Ought to be," she snapped. "None o' thet butchered stuff. This here hog died himself a natchural death!"

' ' '

Wife: Just suppose we wives should go out and strike?

Hubby: Go right ahead, I've got a peach of a strike breaker in mind.



Every Aldrich Direct Flow Pump shown here is operating on present-day water flood projects. The growing number of Aldrich Pumps at work on water flooding or water disposal is proof of Aldrich's qualifications to take care of your requirements—regardless of volume or pressure needed.

Note these reasons why you can consider Aldrich Direct Flow Pumps specially "designed-for-the-job":

- Reduced space between valves affords higher volumetric efficiency.
- Among 3-, 5- and 7-plunger units of the same stroke size: all wearing parts are interchangeable, and a choice of large or small fluid-ends affords a wide range of plunger selection and makes it possible to change plunger size with minimum investment in new parts.
- Operating speeds have been increased—resulting in greater volume and higher pressure from a lighter, more compact pump.
- Drive by direct connection to synchronous engine type, slow speed motor is available, if desired; and all units feature low engine mounting.
- Aldrich "KOSMOS" Porcelain Plungers and valves made of stainless steel or other special material are available to keep corrosion, wear and maintenance time—*down!*

Contact your nearest Aldrich Representative . . . or write us direct for information. Data Sheets are always available on request.

(1) 2⅛" x 3" Triplex..... 500 rpm
2,360 bbl per day.....1100 psi

(2) 1¾" x 5" Triplex..... 320 rpm
1,540 bbl per day.....2500 psi

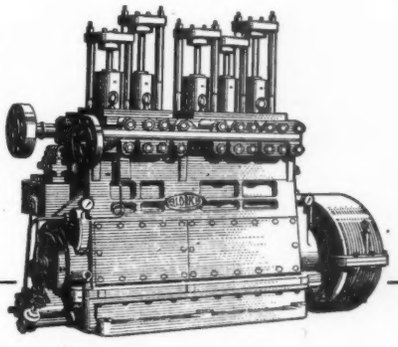
(3) 3¼" x 5" Quintuplex..... 360 rpm
11,100 bbl per day..... 713 psi

(4) 2⅞" x 5" Septuplex..... 375 rpm
11,900 bbl per day..... 910 psi

(5) 4" x 6" Triplex..... 277 rpm
8,720 bbl per day.....1545 psi

(6) 2½" x 6" Quintuplex..... 250 rpm
3,160 bbl per day.....5400 psi

(7) 3½" x 6" Septuplex..... 250 rpm
15,000 bbl per day.....2020 psi



THE ALDRICH PUMP COMPANY

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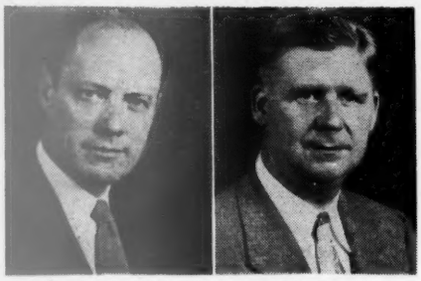
OIL AND GAS TRADE NEWS

Chemicals Division Formed

The Pittsburgh Coke and Chemical Company, Pittsburgh, Pennsylvania, has announced the formation of a new fine chemicals division. The appointment of Dr. L. D. Barrick as manager of the new division and R. M. Locke as assistant manager was announced at the



L. D. Barrick R. M. Locke

same time. Barrick has worked with Gulf Oil, General Aniline and Film Corporation, and as a consultant. Locke served as technical director of dye plant for Arnold, Hoffman and Company, and was employed by General Aniline works, Grasselli, New Jersey, and General Aniline and Film Corporation.

The company has announced completion of the first major unit of its new central research laboratories at Neville Island near Pittsburgh, Pennsylvania. The new unit centralizes a number of research groups previously situated in various points. R. M. Marshall, president of the company, stated that the new laboratories are designed to take care of the additional research requirements stemming from the company's expanding production of chemicals.

Engine Plant Underway

Construction of a new plant near Kansas City, Missouri, for Fairbanks, Morse & Company, will begin at once by Stone and Webster Engineering Corporation, it is announced by Robert H. Morse, Jr., president. Originally planned as a scale plant, it has now been enlarged to approximately 500,000 sq ft of floor space, which includes a foundry, and is to be used to make engines and pumps.

Worthington To Expand Pennsylvania Plant

A $500,000 modernization of its Oil City, Pennsylvania, plant is planned by Worthington Pump and Machinery Corporation. Plans include re-equipping the present foundry and establishing a new electric power supply. The plant has retained Sorbo-Mat process engineers, foundry specialists of St. Louis, to make foundry layouts and develop a method of making castings that is known as "innoculation." New molding machines, sand conditioning and sand supply equipment will be installed in the plant, plus many added facilities.

Brown Courses Set Up

Brown Instruments division of Minneapolis-Honeywell Regulator Company has announced that the first semester of its 1951-52 courses in industrial instrument maintenance and repair begins September 17. This course, conducted annually for more than a decade at the Brown School of Instrumentation at Philadelphia, will continue to December. That and the second semester, beginning in January, will include a 13-weeks comprehensive course concurrently with the shorter classes. Instruction in Brown' yearly classes is being made available to enlisted and officer personnel of the military and for members of various government and defense agencies.

Whitney Chain Company To Build New Plant

The National Production Authority has granted the Whitney Chain Company of Hartford, Connecticut, a Certificate of Necessity to expand its manufacturing capacity. The certificate will be applied against erecting and equipping a new plant in Longview, Texas. It is estimated that approximately 18 months will be required to prepare this additional chain and sprocket manufacturing facility.

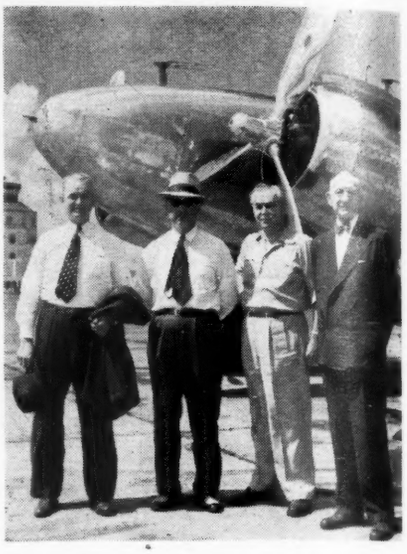
Cathodic Protection Used By Standard Oil Refinery

Cathodic protection division of The Harco Corporation has announced the installation of its system to eliminate electrolytic corrosion in the open-type condenser boxes of a large Cleveland petroleum refining plant. The installation was made in the No. 1 refinery of the Standard Oil Company of Ohio in condenser boxes for the high-heat, high-pressure cracking process prior to storage. Cathodic protection has been installed in the boxes to eliminate costly maintenance and replacement.

Special electrodes have been immersed in the water from the top of the open boxes, and direct current is impressed on these electrodes that radiate through the water to the metal surfaces of the piping and the box. The current enters the metal surfaces and prevents the electro-chemical action which causes corrosion.

Myers Named Agent

Paul W. Myers, newly established petroleum equipment dealer of Mentor, Ohio has been appointed to handle SMITHway service station pumps and SMITHway liquid meters in the greater Cleveland, Ohio area according to announcement of A. O. Smith Corporation, Meter Division. He will make his headquarters in Mentor and will also handle other allied petroleum equipment lines.



Magcobar and Dresser officials took an extensive inspection tour of Magcobar mining and manufacturing facilities recently. The two-week tour took the group to New Mexico, Colorado, Wyoming, and Canada. They are l. to r., A. J. Eastham, assistant secretary and treasurer of Magcobar; Willard M. Johnson, president of Magcobar; J. B. O'Connor, executive vice president of Dresser Industries, and W. C. Ray, assistant to the president of Magcobar.

New Field Store at Odessa

Announcement of the opening of a branch store for Harrisburg Sales and Service. Inc. was made recently from the Houston headquarters of the firm by Charles B. Caldwell, president. The new store is situated at 200 West First Street, Odessa, Texas. In his announcement on the opening, Caldwell said that this was the first field store opened and operated by Harrisburg Sales and Service but that another is now under construction in Oklahoma City and will be in operation within a month. William D. Barnett is in charge of operations in Odessa and Leroy Nix and Monte Kyle Roy are the storemen.

Missouri Firm To Handle Advertising for BS&B

The advertising for the oil and gas equipment and all other divisions and subsidiaries of Black, Sivalls & Bryson, Inc., will be handled by R. J. Potts-Calkins and Holden, Inc., Kansas City, Missouri, effective October 1, Henry A. Ruysser, Jr., BS&B vice president in charge of sales and advertising, has announced. The oil and gas equipment division is now in process of doubling the capacity of its Oklahoma City plant. All oil and gas equipment production activities and the oil and gas equipment engineering and sales division are being concentrated there.

Bethlehem Opens New Abilene, Texas Store

Bethlehem Supply Company announces the opening of a new store at Abilene, Texas. This store has been erected at South 15th Street. The Cisco, Texas store will be combined with the new Abilene store. Increased storage space has been made available for stocking a well rounded inventory of drilling, production, refining, and pipe line equipment and supplies. C. A. (Chuck) Pigg, who has been in charge of the Cisco store, will be store manager and field representative. He will be assisted by S. J. (Sid) Donalson, Jr., and J. S. (Jess) Weaver as field representatives.

Graybar To Be IT&T Agent

Appointment of Graybar Electric Company, Inc., as national distributor of its railroad communications and signaling equipment was announced by Federal Telephone and Radio Corporation, Clifton, New Jersey. As Federal's representative in the U. S. Graybar will afford American railroads a new, nation-wide source of supply for electronic and communication equipment. In its initial stage, Graybar representation will cover Federal PTM (pulse-time modulation) microwave systems, carrier telephone and telegraph systems, telephone equipment, railroad and vehicular mobile radio, and a variety of battery chargers. Graybar also will offer sequence switch interlocking. developed by IT&T associates as a new type of automatic system for railroad signaling, and radio telephone and passenger entertainment distribution.

Trucking Industry Portrayed

Mack Trucks, Inc., has announced the release of a 2-color, 8-page booklet, entitled "National Security Rides on Trucks." This booklet is designed to meet the needs of educators, commentators, editors, group leaders, etc., by giving them a factual and dramatic highlight summary of the importance of the trucking industry to the country's economy, includes quotations from high military and government officials as to the vital necessity of trucking, and cites the results of special surveys into civilian defense and defense economy needs.

Ensign Expands Facilities

Ensign Carburetor Company has announced acquisition of a new building for expansion of the company's manufacturing operations. In establishing this plant No. 3, Ensign will concentrate in its new quarters on assembly operations, stock rooms, ordering, and shipping departments. This will release considerable space in the main plant in Huntington Park, as well as in the Chicago plant for further expansion of manufacturing facilities.

Trojan Offices Moved

Trojan Construction Company, Inc., has announced moving of its offices to 1416½ North Robinson, Oklahoma City, Oklahoma. The company was formerly at 2519½ South Robinson.

New Offices Rented

Manning, Maxwell and Moore, Inc., manufacturers of valves, gages, instruments, cranes, and hoists, have rented a large portion of the eleventh floor of the new 32-story Chrysler Building East, New York City. Tenants of the orignial Chrysler Building, second tallest building in the world, Manning, Maxwell and Moore, Inc., at present occupy the entire sixty-fifth floor. They will move into the new, fully air-conditioned Chrysler Building East, which adjourns the original building, as soon as it is available. It is scheduled for completion on or about November 1, 1951.

Cleco Names Distributors

The Cleco division of Reed Roller Bit Company, has announced the appointment of Highway Machinery and Supply Co., Inc., Richmond 21, Virginia; Sterling Sales, Inc., Worcester 3, Massachusetts; and Wallner Welding Supply Company, Duluth, Minnesota, as distributors for Cleco products in their areas.

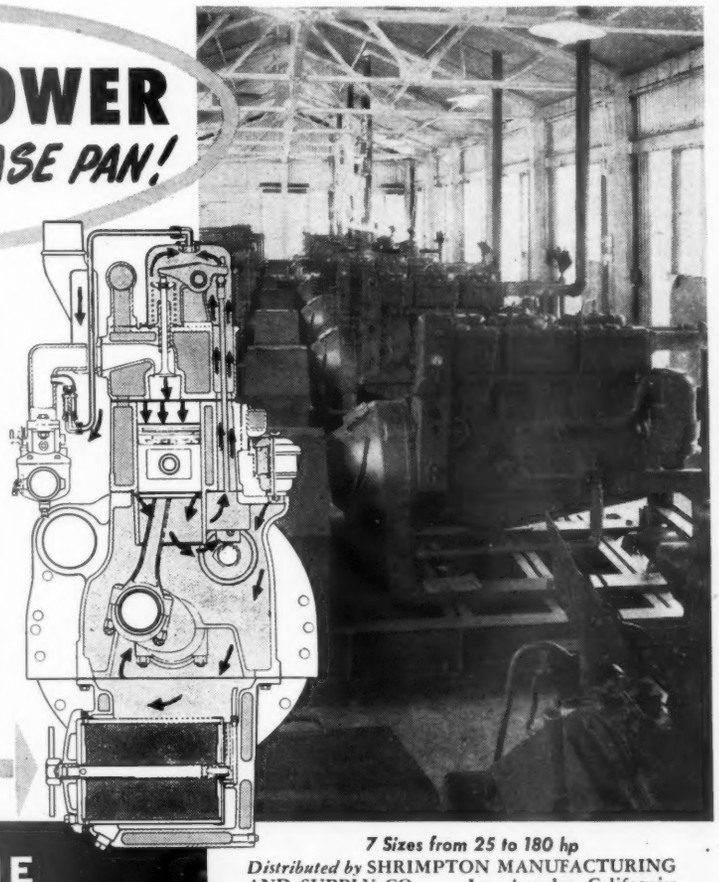
MM MINNEAPOLIS-MOLINE MODERN MACHINERY

OILFIELD POWER
WITH HEAT EXCHANGER BASE PAN!

MM HEAT EXCHANGER BASE PAN maintains uniform operating temperature from top to bottom of the engine regardless of load or atmospheric temperature. This results in a sludge-free engine . . . best oil filtering . . . greatly extended periods between servicing . . . far fewer oil changes . . . and greatly prolonged engine life.

HERE'S HOW IT WORKS: The base pan is cast with water jackets just like the cylinder blocks and heads. A heavy-duty by-pass thermostat diverts the water from the outlet manifold through the base pan jacket and back through the pump and engine. Circulating the hot water around the oil in the pan eliminates outside radiation and maintains 165-180° temperature for ideal lubrication and filtering.

Positive Vacuum Crankcase Ventilation draws 2 to 3 cu. ft. of fresh air per minute through a metering valve. After mixing with oil-contaminating gases, raw and burned, it is withdrawn through the cylinder head covers and into the intake manifold. Investigate MM Oil Field Power . . . the engine with lower field service cost.



MINNEAPOLIS-MOLINE
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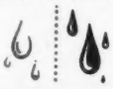
7 Sizes from 25 to 180 hp
Distributed by SHRIMPTON MANUFACTURING AND SUPPLY CO. . . . Los Angeles, California; Oklahoma City, Oklahoma; Kilgore, Texas

JOHNSTON CONSTRUCTION gives you MORE for your pumping dollar

No other type pump can match Johnston Pumps for high efficiency... for adaptability to varying job requirements... for low maintenance and operating costs... for all-around ability to handle virtually *any* pumping application encountered.

Among the many construction features that make Johnston Pumps so uniformly efficient under a wide variety of operating conditions, the following are typical...

VERTICAL DESIGN—The motor head is at the surface where it can be serviced and lubricated easily... No costly foundations are needed... The pump unit is at the water level where it is always primed, ready to go.



OIL OR WATER LUBRICATION—Johnston Pump Company makes both oil- and water-lubricated pumps. Selection of the type is dependent on the type of installation and other factors Johnston engineers consider in making recommendations.

CHOICE OF IMPELLERS—Either bronze or cast iron Vitreous Enameled closed type impellers are furnished on Johnston Pumps. All controlling factors—well conditions, lift, capacity, pressure—are studied before one or the other is recommended. Semi-open type impellers are ideally suited to some conditions. They will not freeze or clog where the liquid contains gritty or pulpy matter. The clearance between impeller and bowl seat can be adjusted at the surface to suit the particular conditions under which the pump is operating.

For better vertical pumps, go to your local Dealer at the sign of the Johnston "J." Johnston Pump Company, 3272 E. Foothill Blvd., Pasadena 8, California

For complete information and the name of your nearby Dealer drop us a card.

JOHNSTON TURBINE PUMPS

Little Beaver — For 4" Minimum Well Size

Deep Well Turbines — Oil or Water Lubricated

Junior Turbines — Big Pump Features and Small Pump Economy

Propeller and Mixflow — Large Capacity at Low to Medium Heads

New Plant in Operation Makes Synthetic Catalysts

American Cyanamid Company's new three million dollar plant in Michigan City, Indiana, begins production about August 15. This was announced by Arthur J. Campbell, general manager of the company's industrial chemicals division. The plant will produce synthetic cracking catalysts used by oil refiners in making high octane gasoline and other high grade fuels.

The Michigan City plant will produce catalysts for numerous oil refiners who have catalytic cracking plants throughout the Midwest and along the Atlantic seaboard. In these units, known as "cat crackers," the catalyst "cracks" the large molecules of semi-refined petroleum into the smaller molecules that make up high octane fuels, raw materials for synthetic rubber, and other highly important petroleum products.

Griscom-Russell Moves General Offices to Ohio

The Griscom-Russell Company has moved its general offices from New York City to Massillon, Ohio, where the company's plant for manufacturing heat transfer apparatus of all types is situated.

The move has been made to centralize the administration, general sales, engineering, development and other departments of this 84-year-old business for most efficient operations and service in the interests of the National Defense effort and customers. To accommodate the various departments, a new office building is being erected on the grounds of the company's plant opposite the Massillon station of the main line of the Pennsylvania Railroad.

Water Heater Distributors Named By A. O. Smith

Mell O. Haldeman Corporation of Los Angeles has been appointed A. O. Smith Permaglas and Duraclad water heater distributor for Southern California, including both the Los Angeles and San Diego areas. Sales Manager George Souther announced plans for building a display trailer to show representative models of Permaglas and Duraclad water heaters to customers and prospects.

Plan Oxygen Plant

Chemical plants division of Blaw-Knox Company is handling an order from the Houston Oxygen Company for supplying of an oxygen plant, to be situated at Houston, Texas. The equipment will be supplied by Blaw-Knox's German associates, Gesellschaft fuer Linde's Eismaschinen, at Hoellriegelskreuth, Germany. The plant, which will be a complete air separation unit, will produce 18 tons per days of liquid oxygen of 99.7 per cent purity; 10,000 cu ft per day of argon of 99.9 per cent purity; and some nitrogen of high purity. Space is being provided to duplicate the production capacity at a later date.

Forms Engineering Company

Formation of CRC Engineering Company, a new organization to provide complete engineering design services for crude, gas, and products pipe lines including economic studies of proposed projects, has been announced. Headquarters of the new company will be in Houston.

H. E. Fisher

Partners in the firm are H. E. (Herb) Fisher, A. S. Crutcher, Gene Rolfs, and Jim Cummings. Fisher, who recently resigned as chief engineer of Standard Oil Company (Indiana), has been associated with the engineering design and construction of pipe lines for 20 years.

Cook Expands Facilities

The C. Lee Cook Manufacturing Company, Incorporated, of Louisville, Kentucky has announced plans for expanding its production facilities to meet the increased demand for its products — Cook metallic rod packings and graphitic iron piston rings. It is expected that the program will be completed within the next several months and that present capacity will be increased approximately 50 per cent.

Cleco Names Distributors

Cleco Division of the Reed Roller Bit Company, Houston, Texas, has announced appointment of the following distributors: Red Arrow Sales Corporation, Madison, Wisconsin; Martin Manufacturing Company, Los Angeles, California; Knox-Tenn Equipment Company, Knoxville, Tennessee; Franklin Supply Company, Providence, Rhode Island; J. Heller and Sons, Inc., Newark, New Jersey; Someset Pneumatic, Inc., Sommerville, New Jersey; The Ridley Company, San Francisco, California; A. J. Baxter and Company, Detroit, Michigan; Gesner Equipment Corporation, New Haven, Connecticut; Dawson Tool and Abrasive, Inc., Seattle, Washington, and Cohen Auto Parts, Inc., Erie, Pennsylvania.

Rubber Latex Developed

U. S. Rubber Company has announced development of "cold" synthetic rubber latex said to be the first to approach natural rubber latex in service and wearing quality. A company spokesman reported that many types of synthetic rubber latex have been produced experimentally, but the new "cold" varieties are the first of the GR-S or general purpose type, which promise to compete with natural rubber latex in large volume applications in the rubber industry.

FLOOD WATERS INUNDATE K. C. INDUSTRIAL DISTRICT

When a flood swollen torrent crashed through the barrier protecting the central industrial district of Kansas City, Kansas, Columbian Steel Tank Company was one of the many businesses lying defenselessly in its path. On the morning of July 13, Friday, a wall of water three feet high, traveling at 15 miles an hour came roaring down on the city, and in four hours, Columbian production facilities, storage lots, and car-loading areas were under more than 15 ft of muddy water. Columbian workmen saw the engulfing tide rolling toward the company and a foreman warned the switchboard operator. Nine minutes after the warning, there was no escape from the buildings by foot, nor from stranded vehicles.

Flood waters completely covered the stranded vehicles on Twelfth Street in front of Columbian Tank Company. At right is escape ladder leading from second floor of the office building.

Looking out from Columbian offices during flood, the Gustin-Bacon Manufacturing Company sign can barely be seen above the flood waters. Men in rescue skiff are out rendering aid to stranded workers.

The adage "nothing floats like a tank," was proved significantly by these derailed freight cars. These tanks, ready for shipment, were securely lashed to the flat beds and did not get away.

Workers probed for some submerged obstacles where W. M. Gadberry, Columbian sales manager, abandoned his automobile (lower right) in alley behind office building.

Chemico Will Utilize New Acetylene Process

The Chemical Construction Corporation of New York, a unit of the American Cyanamid Company, has acquired from Badische Anilin & Soda-Fabrik the exclusive North American rights to use their process for the design and construction of plants, which produce acetylene from natural gas.

The basic steps of this process are: First, natural gas hydrocarbons are partially oxidized to supply a crude acetylene gas. This is then purified to yield acetylene of any desired purity. The "heart" of the process is the use of a selective solvent specially developed.

Rollans-Elliott Named By New Deal Specialty

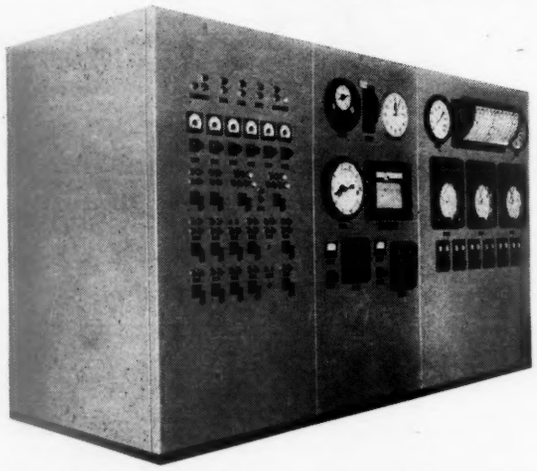
New Deal Specialty Company, Okmulgee, Oklahoma, has announced the appointment of Rollans-Elliott Company of Tulsa as their representative in the Permian Basin area, with headquarters at Odessa, Texas. Dean Rollans, of the Rollans-Elliott firm, stated that they will carry the entire line of the New Deal Specialty products. The Odessa branch is under the supervision of Jean G. Hollis, manager, and W. D. "Bill" Campbell, assistant, both of whom have had many years of oil field experience.

How to SAVE VALUABLE TIME..

ON THE PURCHASE AND INSTALLATION OF

ELECTRICAL CONTROL BOARDS

● **Write ONE purchase order for a COMPLETE control board . . . then leave everything else to us!**



"NEMCO" Double-Faced Combination Turbine and Boiler Control Board . . . piped, wired and tested at factory—then shipped AS A COMPLETE UNIT. Lighting canopy (not shown) was also shipped complete.

At the Nelson factory we will procure all necessary instruments and other components; we will do all of the fabricating, all of the wiring, all of the piping and all of the testing.

Then the control board will be shipped *as a complete unit* to your plant location. This reduces field work to an absolute minimum and speeds up completion dates. As a result, many valuable hours are saved.

We will appreciate the opportunity of quoting on your requirements for control boards, instrument panels and motor control centers.

NELSON *Electric* MANUFACTURING CO.

217 North Detroit TULSA, OKLAHOMA Telephone 2-5131

Phil Renn at Houston For Oil Base, Inc.

Oil Base, Inc., manufacturers of Black Magic, White Magic, and oil base and conditioners, announce the establishment of a Gulf Coast office at Houston with Phil Renn in charge. Renn comes to Oil Base from Cardinal Chemicals, Inc., where he was in charge of the Gulf Coast area. He is a graduate in chemical engineering from Rice Institute.

Phil Renn

United Supply to Add Ideco Drilling Rig Line

United Supply and Manufacturing Company has added the IDECO line of drilling rigs to its long list of drilling and production equipment, it was announced recently by H. B. Gutelius, Jr., vice president. United will stock IDECO accessories and will also maintain a service department in each store for IDECO equipment.

Welex Jet Sets Up New Mexico Store

Welex Jet Services, Inc., has recently opened a new field station at Hobbs, New Mexico. The station is situated at 110 South Grimes Street. Station manager is Ray H. Williams, who has been with Welex as sales engineer for the past year and a half. W. D. Smith has been promoted by Welex to assistant manager at the Hobbs Station. He is an engineering graduate of University of Oklahoma.

Turco, Dy-Check Agreement

Dy-Check Company has made a licensing agreement with Turco Products, Inc. in Los Angeles, California, whereby Turco will begin manufacturing and distribution functions immediately. Nationwide field service and overnight delivery of Dy-Check materials will be available in the near future. Dy-Check is the dye penetrant method of inspection developed by Dy-Check Company and its parent company, Northrop Aircraft, Inc.

Rubber Plant Expanded

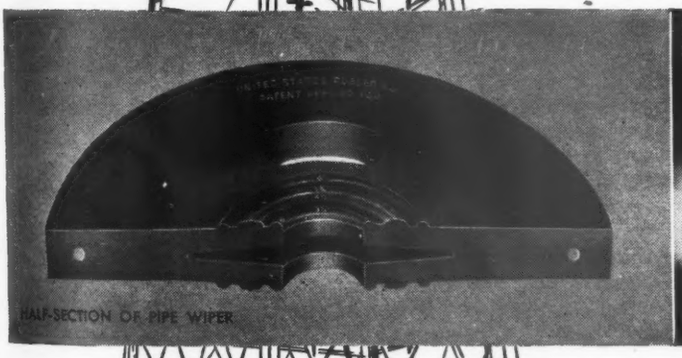
Naugatuck chemical division, United States Rubber Company, has announced a major expansion program aimed at doubling the production of its Baton Rouge, Louisiana, Paracril synthetic rubber plant. Plans call for the construction of a new administration building, laboratory, gate house, as well as new reactors, drying units, and other production equipment. New warehousing and latex storage facilities will also be added.

What's U. S. Rubber doing for your drilling dollars?

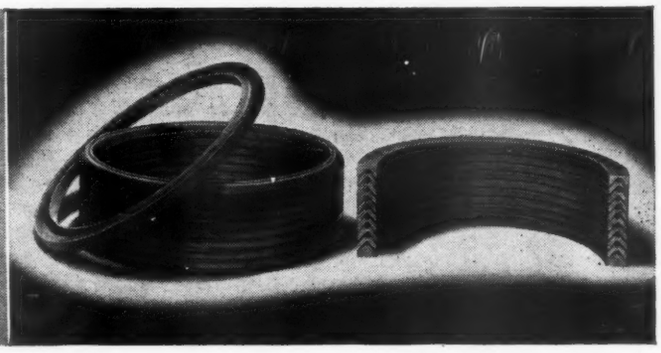
THIS NEW "U. S." PIPE PROTECTOR prevents wear on the casing or tool joint. Lowers vibration, friction and torque during drilling, resists cutting, abrasion, swelling and the effects of oil and acid. Knurling on the inside protects against seepage or slippage. Can be used with any kind of drilling mud.

NEW DOUBLE-LIP PIPE WIPER gives twice the wiping action of a single-lip wiper at single-lip cost. Does the work of two single-lip tandem wipers, and the field reports amazing service. Lips will stretch five times their size without damage.

MANY OF THE LARGEST makers of rotary drilling rigs select U. S. Matchless Packing (below) as original equipment. Its self-adjusting, automatic action reduces wear on rods and plungers at pressures as high as 8,000 lbs. psi.



HALF-SECTION OF PIPE WIPER



These are just a few of the products "U. S." makes for the oil fields. They are weapons the driller uses in his constant battle against time, against shutdowns, against rising costs. "U. S." technicians, closely studying oil field requirements, are developing newer weapons all the time, backed by the most modern of physical and chemical laboratories and research units. Rely on United States Rubber Company products to save you drilling dollars.

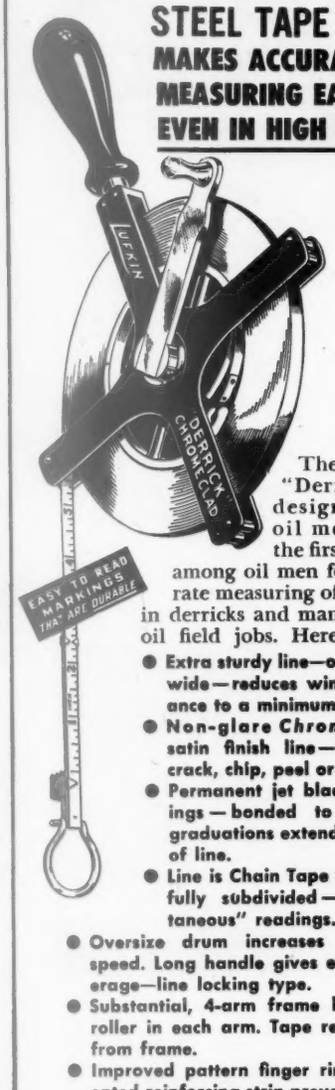
UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

STURDY NARROW LINE ASSURES EASIER HANDLING

LUFKIN

"DERRICK"
CHROME-CLAD
STEEL TAPE
MAKES ACCURATE MEASURING EASY... EVEN IN HIGH WIND



The *Lufkin* "Derrick" — designed by oil men — is the first choice among oil men for accurate measuring of casings in derricks and many other oil field jobs. Here's why:

- **Extra sturdy line—only ¼-in. wide—reduces wind resistance to a minimum.**
- **Non-glare *Chrome-Clad* satin finish line—will not crack, chip, peel or corrode.**
- **Permanent jet black markings—bonded to steel—graduations extend to edge of line.**
- **Line is Chain Tape weight—fully subdivided—"Instantaneous" readings.**
- **Oversize drum increases winding speed. Long handle gives extra leverage—line locking type.**
- **Substantial, 4-arm frame has tape roller in each arm. Tape removable from frame.**
- **Improved pattern finger rings. Patented reinforcing strip prevents kinking and first end breakage.**
- **Hook is securely riveted to lip of detachable, swinging ring.**

In 100-ft., 150-ft. and 200-ft. lengths marked feet, 10ths and 100ths; or feet, inches and 8ths. See them at your Supply House. 87

Buy LUFKIN

TAPES · RULES · PRECISION TOOLS

THE LUFKIN RULE CO., SAGINAW, MICHIGAN
102-138 Lafayette St., New York City • Barrie, Ont.

Taylor Produces Film

Under the title, "Information At Work," the Taylor Instrument Companies of Rochester, New York, have released a narrated 30-minute, 16mm, colored moving picture depicting in fast-flowing, comprehensible style the growth and significance of instrumentation. Aimed primarily at audiences composed of people whose understanding of industrial instrument application would be enhanced by a sweeping view of the whole field, the film achieves a nice balance between education and entertainment. Script for the film was written by Oeveste Granducci of Washington, D. C., and the producer is McLarty Picture Productions of Buffalo, N. Y. The Taylor company is handling the distribution of the film and requests for loan should be be made to: Taylor Instrument Companies, Public Relations Dept., 95 Ames Street, Rochester 1, N. Y.

Key Division Transferred

Whitney Chain Company, Hartford, Connecticut, announces the transferal of their Woodruff key division to Standard Steel Specialty Company. This assignment includes manufacturing equipment and stock inventory of this division. The Woodruff system of keying was introduced to industry by the Whitney Chain Company in 1896. Whitney Chain Company stated that the transferal was made necessary due to the need for utilizing complete plant capacity for the production of their power transmission and conveying chain products.

Halliburton Lab Complete

A new research electrical well services research laboratory for Halliburton Oil Well Cementing Company of Duncan, Oklahoma, has been completed at Houston, Texas, by The H. K. Ferguson Company. Facilities will include 12 laboratory-offices, a library, conference room, inspection room and drafting room. The brick veneer building will be air conditioned.

Louis Allis Company Sees Its 50th Anniversary

The Louis Allis Company of Milwaukee, Wisconsin has recently published a booklet celebrating its 50th anniversary. The company was founded 50 years ago by Louis Allis, son of one of the founders of Allis-Chalmers Manufacturing Company.

Louis Allis became interested in a small firm, the Mechanical Appliance Company, which was making a new "wonder machine" an electric motor, in 1901. That same year he invested in the new company, became a director, and took an active part in the management of the company. In 1903 he was elected its president, and the name was later changed to the the Louis Allis Company. Allis served the company as president until he retired in 1945. Present head of the company is E. P. Allis, son of the late founder.

MERCOID

THEY ARE USED FOR THE CONTROL OF TEMPERATURE, PRESSURE, LIQUID LEVEL AND MECHANICAL OPERATIONS.
THE MERCURY SWITCH IS A FEATURE IN MERCOID CONTROLS THE REASON FOR THE MERCURY SWITCH IS THE ADDED SAFETY, BETTER PERFORMANCE AND LONGER CONTROL LIFE—ALL OF WHICH ARE IMPORTANT WHEREVER CONTROLS ARE REQUIRED
WHY CONSIDER LESS WHEN YOU CAN GET SO MUCH MORE

WRITE FOR COMPLETE CATALOG

THE MERCOID CORPORATION
4201 BELMONT AVE. CHICAGO 41, ILL

Business in
TULSA
means—

THE MAYO

★ Air Conditioned ★ Centrally located ★ Adjoining Garage ★ Coffee Shop

The Oil Man's Hotel in The Oil Capitol of The World

TRADE PERSONALS

Herman R. Powers has been named to fill the newly created position of industrial department field manager for National Aluminate Corporation. A Nalco employee since 1935, Powers was formerly district manager of the Pittsburgh, Pennsylvania territory. Powers will be replaced at Pittsburgh by **I. A. Clausen**, former assistant district manager under R. I. Moran in New England. **Forrest Bryan**, who joined the company in May, will succeed Clausen.

J. C. Newman has been appointed sales manager for Gulf Coast Machine and Supply Company. Newman has been with the company since 1937. He went to work in the oil fields as rough neck in 1931, and was later tool pusher. He joined Gulfco from Oil Well Supply Company.

J. C. Newman

Ellsworth W. Hudgens, has been added to the staff of Dowell Incorporated as a development engineer specializing in cathodic protection for retarding electrolytic corrosion of pipelines, industrial equipment, and other buried and submerged metals. Hudgens, who will be in Dowell's general office in Tulsa, Oklahoma was formerly with the Gulf Oil Company. Previous to that the new development engineer was an instructor in chemical engineering at the Missouri School of Mines, at Rolla. Hudgens served as a lieutenant in the army from 1943 to 1945.

E. G. Langhammer, San Antonio, Texas, has been appointed representative for Builders-Providence, Inc. and Omega Machine Company, divisions of B-I-F Industries. Langhammer, president of the Texas Filter Company, will also continue to represent %Proportioneers, Inc.%

V. de P. Gerbereux has been appointed manager of the centrifugal pump sales division of Worthington Pump and Machinery Corporation. He succeeds **A. H. Borchardt** who was recently elected vice president in charge of centrifugal, reciprocating and vertical turbine pump sales. Gerbereux was graduated from Cornell University with a mechanical engineering degree in 1924 and the same year took the Worthington Student Training Course.

V. de P. Gerbereux

J. L. Singleton, vice president in charge of the general machinery division, and **R. S. Stevenson**, vice president in charge of the tractor division, have been elected to the board of directors of Allis-Chalmers Manufacturing Company. They succeed as directors the late Walter Geist and W. C. Johnson. **W. E. Hawkinson**, secretary and treasurer of the company, was named a vice president, secretary and treasurer.

J. N. (Babe) Wofford, age 50, Houston, Texas died at his home on July 28. "Babe" Wofford was widely known by oil operators throughout the Mid-Continent and Gulf Coast, where he worked for the past 25 years as representative for the Parkersburg Rig and Reel Company. A native of Temple, he began his career in the oil business at Ranger, Texas as representative for Parkersburg. He was a special representative for the Southern division with headquarters in Houston at the time of his death.

Boyce F. "Bud" Corbin has been appointed sales and service representative for oil tool division, Byron Jackson Company, covering the Illinois, Indiana and Michigan territory. Corbin will make his headquarters in Olney, Illinois. For the past several years, he has been associated with Loffland Bros., Fred Manning, and Brinkerhoff Drilling Companies.

B. F. Corbin

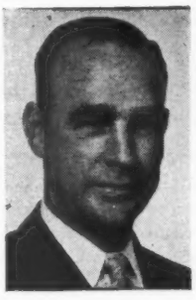
Ray S. Ousterhout, former development engineer with Dowell in Odessa, Texas has been transferred to the Midland, Texas district office and promoted to district sales engineer. A graduate of the University of Tulsa, Ousterhout joined Dowell in 1943. Before his recent appointment Ousterhout served as service engineer in El Reno, Oklahoma.

William M. Hawkins, American Car and Fonndry Company laboratory director at Berwick, has been appointed senior research engineer at New York in the research and development department. **George Reed**, ACF manager of inspection, succeeds Hawkins at Berwick but with the new title of manager, general laboratories. **Sheldon Thomas**, formerly resident representative at the Chicago plant, has been appointed manager of inspection, succeeding Reed. Hawkins is a graduate of both Harvard and Chrysler Institute of Engineering. Reed holds a master of science degree in metallurgy from the University of Michigan. Thomas has been with ACF since 1940, beginning as a draftsman.

F. H. Isaacks

M. L. Hooks

G. L. Teer, Cameron Iron Works, Houston, Texas, has been made division manager of the Houston division; **F. H. Isaacks** has been appointed division manager of the Southwest Texas division; and **M. L. Hooks** has been promoted to division manager of the Rocky Mountain division. Teer was formerly district sales manager in Corpus Christi; Isaacks, until his recent appointment, was sales representative in New Iberia, Louisana; and Hooks held the same position in Casper, Wyoming.



G. L. Teer

Curtis Bonneville has been named as general foreman of Kaiser Steel's merchant-skelp mill. For the past several years, Bonneville has served as shift foreman in this department, one of Kaiser Steel's eight rolling mills.

Bonneville attended DeVippe and Roosevelt military academics, graduating in 1933 from Peekskill Military Academy. He joined Kaiser Steel's Fontana Works in 1942.

Robert O. Evans has been appointed executive assistant to **Kenneth T. Snyder**, general manager of the Western division, Atlas Mineral Products Company. Evans is a graduate of Baylor University and was formerly associated with the Sheffield Steel Corporation.

Stuart E. Corry has been appointed sales manager of Franks Manufacturing Corporation of Tulsa replacing **A. H. Knight**, resigned.

Corry has served Franks in both engineering and sales capacities since 1943, including positions of assistant chief engineer, chief products engineer, Illinois district sales manager, Texas Gulf coast district manager of sales and service. He studied mechanical engineering at Texas Tech, Lubbock, and also attended Tri State College, Angola, Indiana. Carl White, Jr., is Franks president.

S. E. Corry

J. H. Sells

H. E. Humphreys

J. H. Sells has been named to succeed **M. F. Groom** as head of Rockwell Manufacturing Company's New Orleans office. A graduate of Texas A. & M., Sells was formerly employed by Shell Oil Company. He joined Rockwell three years ago and since that time has been handling the sales of all products in the Alexandria, Louisiana, area.

H. E. Humphreys, Jr., president of United States Rubber Company, has been elected chairman of the board of directors. He will continue as president. Humphreys will succeed **Herbert E. Smith,** chairman and former president, who retired after 38 years of service. Smith will continue as a director and member of the finance committee. The board also elected **John W. McGovern,** vice president and general manager of the tire division, a member of the executive committee. **Howard N. Hawkes,** assistant general manager of the tire division, was elected a vice president and appointed general manager of the tire division to succeed McGovern.

S. D. Andrews, who joined General Controls Company of Glendale, California, three years ago as an employee in the company's San Francisco branch. has been appointed branch manager of the Dallas, Texas, office. Andrews will replace **Robert Farmer** who will return to the Glendale plant as a factory engineer. Andrews formerly was employed by North American Aviation and the Alemite Company of Southern California. Prior to joining General Controls, Andrews was a partner in a firm specializing in the installation of industrial lubricating equipment.

Ralph L. Boyer, vice president and chief engineer of The Cooper-Bessemer Corporation, Mount Vernon, Ohio, has been awarded the Lamme Medal, one of Ohio State University's highest honors. The 1951 awarding of the Lamme Medal was made to Boyer for the development of today's important gas-diesel engine and the high compression spark-ignited gas engine. While an undergraduate, and 2 years after graduation in 1924, Boyer worked with Dr. Elmer Sperry in the pioneering development of the compound diesel engine. In 1926, he joined The Cooper-Bessemer Corporation as diesel engineer.

R. L. Boyer

G. G. Bledsoe

L. V. Thomas

George G. Bledsoe has been appointed sales engineer of industrial accounts in the Chicago, Illinois area, for Rockwell Manufacturing Company. A graduate of Akron University, Bledsoe formerly served as sales promotional representative for the Pittsburgh Valve and Fittings Corporation.

L. Vincent Thomas, formerly district supervisor for Core Laboratories, Inc., in North Texas and Oklahoma, has been advanced to sales engineer with offices in Fort Worth, Texas. **John I. Caldwell,** Midland, is now representing the firm as sales engineer for the entire West Texas area; **V. B. Ogden** has been appointed district supervisor of permanent lab operations in Midland, Abilene, Post, and Lubbock, and **Alvis O. Byrd** has been placed in charge of all Core Lab formation logging operations in the Permian Basin.

R. C. Wilshusen has been promoted to the position of district supervisor for Core Lab formation logging, diamond coring, core analysis, and reservoir fluid analysis operations in Oklahoma, North Texas, Kansas, and Indiana; **Ralph Jenkins** has been advanced to district supervisor of the Rocky Mountain area; and **C. D. Holden** has been appointed to the same duties for Core Lab in California.

Howard I. Dickson, formerly manager of the sales order department of Chiksan Company, Brea, California, has been promoted to the position of industrial salesman in the Los Angeles area. Dickson has been a member of the Chicksan Sales Department for several years.

Hendley Blackmon has been named manager of engineering association activities for the Westinghouse Electric Corporation. He will work with Westinghouse engineers in the preparation of papers to be presented before engineering association meetings. Blackmon, who has served as assistant manager of the activity since 1949, succeeds **Frank Thornton, Jr.,** who recently retired. He was graduated from the Georgia School of Technology in 1925 with a Bachelor of Science degree in electrical engineering. After some time with McGraw Hill Publishing Company, he was returned to the company as assistant manager of engineering association activities in 1949.

WANTED—An Oil Tool Salesman

Byron Jackson Company, manufacturers of oil tools distributed this list of requirements for an oil tool salesman:

Must be a man of vision and ambition, an after dinner speaker, before and after dinner guzzler, night owl, work all day and drive all night and appear fresh the next day. Learn to sleep on the floor and eat two meals a day to economize on traveling expenses so you can entertain your friends in the next town.

Must be able to entertain customers, wives, sweethearts, and pet stenos without becoming too amorous. Inhale dust, drive through snow ten feet deep at ten below and work all summer without perspiring or acquiring B.O.

Must be a man's man, a lady's man, a model husband, a fatherly father, a good provider, a Plutocrat, Democrat, Republican or New Dealer, an old dealer, and a fast dealer, a technician, politician, mathematician, and mechanic.

Must be a sales promotion expert, create a demand for obsolete merchandise, be a good credit manager, correspondent, attend all dealer meetings, tournaments, funerals, visit customers in hospitals and jails, contact all accounts every six weeks, in spare time look for new business, do missionary work, attend factory sales conferences.

Must have unlimited endurance, and frequent over-indulgence in wine, women, wind, and gab, a wide range of telephone numbers in all principal cities. Must have a car, attractive home, belong to all clubs, pay all expenses at home, and on road, on five pre cent commission. Price chiseling and bad debts will be deducted from monthly commissions, plus 2 per cent excise tax, 1 per cent old age pension, and 3 per cent "Lost Sales Tax."

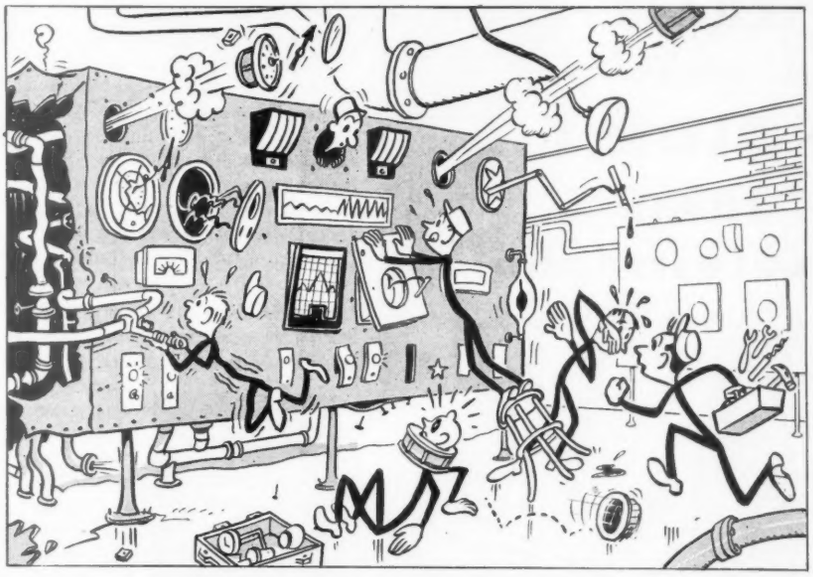
Must be an expert driver, talker, liar, dancer, traveller, bridge player, poker hound, golf player, diplomat, financier, capitalist, philanthropist, and authority on palmistry, chemistry, physiology, psychology, dogs, cats, horses, brunettes, blondes and redheads, etc.

Is it any wonder that "good salesmen" are hard to find?

Bouncing Pipes give a Plant the Jitters

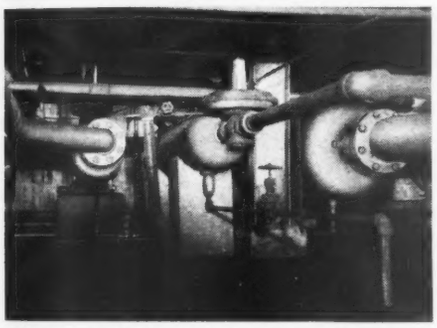
★ FOR SURGE CONTROL IN GAS AND AIR LINES CONSULT BURGESS-MANNING ENGINEERS

Pipes that bounce and vibrate are a nuisance . . . and a plant with the jitters is not operating at top efficiency. To help you solve this problem, Burgess-Manning has developed a Gas and Air Line Snubber which effectively reduces surging . . . practically eliminating the resultant vibration of gas and air lines excited by compressors, blowers, or reciprocating pumps. To aid you in maintaining the operation of your plant at rated capacity, consult Burgess-Manning.

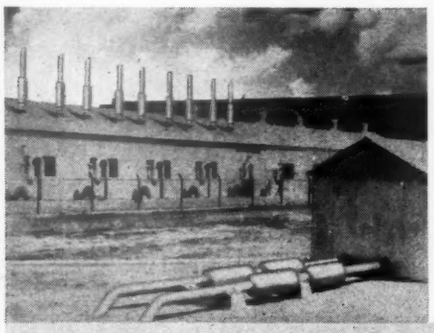


BURGESS-MANNING COMPANY

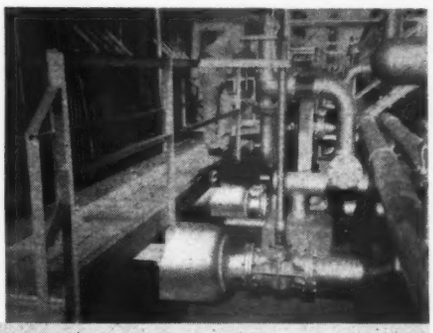
749 East Park Avenue, Libertyville, Illinois
1203 Dragon Street, Dallas, Texas



Gas and Air Line Snubbers installed on the first stage and the high stage of an Ingersoll-Rand Compressor.



Four Burgess-Manning Gas and Air Line Snubbers installed ahead of two meter runs at a Wyoming recycling plant.

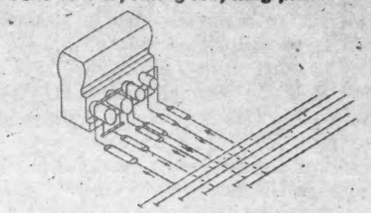


Burgess-Manning Gas and Air Line Snubbers installed on the discharge side of a compressor at a natural gasoline plant.

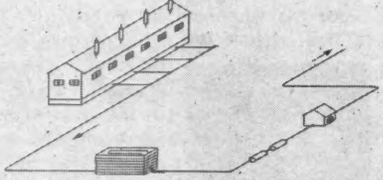
Bulletin 92, "Surge Control."

Booklet, "Bouncing Pipes."

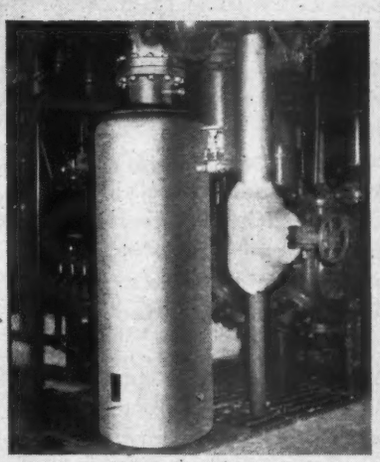
The function of the Burgess-Manning Gas and Air Line Snubber is to prevent the rapid pressure change, which occurs at the compressor or blower, from being transmitted to the pipe line.



Snubbers reduce vibration in all lines due to the intermittent suction or discharge of compressors and blowers.

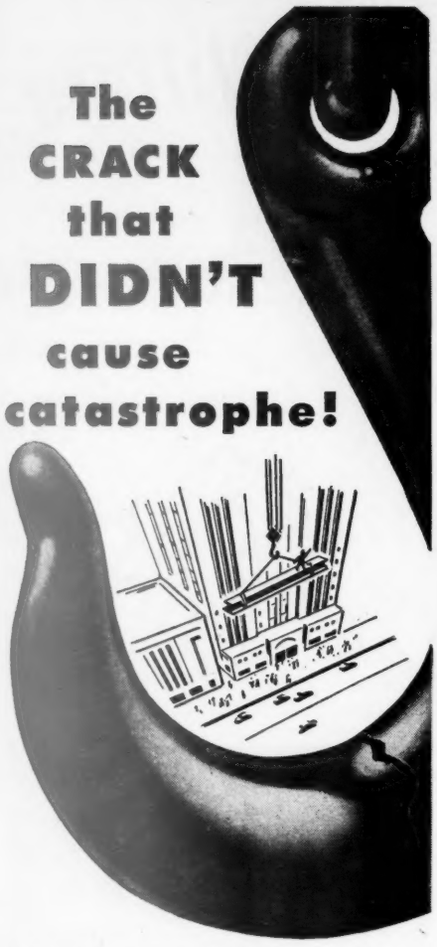


Gas and Air Line Snubbers smooth the flow of gas without constriction and stop vibration without mechanical damping. Metering fluid flow is greatly simplified.



Burgess-Manning Gas and Air Line Snubber installed on discharge side of a compressor at an Oklahoma refinery.

RANGE OF OPERATIONS Burgess-Manning Gas and Air Line Snubbers, custom designed and fabricated around a wide variety of standard parts, are specifically engineered to meet any or all of the following design requirements: all pressures—up to 5,000 psi • all gases and mixtures of gases. These include, among others, hydrogen, butadiene, ammonia, propane, and freon • all weights of gases—molecular weight as low as 7 to as high as 120 • all pipe sizes—as large as 24" diameter pipes • Gas and Air Line Snubbers are designed to meet ASA, ASME, and API-ASME Construction Code requirements. Snubbers can be constructed to conform to the code requirements of any state.



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▸ **Vincent Lysaght** has been appointed sales manager of the Helicoid gage division of American Chain and Cable Company, Inc. He has directed the sales of the Campbell machine division and Wilson mechanical instrument division (Rockwell hardness testers) in the past. A graduate of MIT in 1924, Lysaght became laboratory technician with the Wilson Mechanical Instrument Company, and Wilson Maeulen pyrometers. **John Morrison** has been appointed product manager and will assist Lysaght in sales development activities in the field. Morrison has been engaged in sales work in the gage field for a number of years.

▸ **L. L. Garber,** vice president, H. K. Porter Company, Inc., has been appointed general manager of the company's Hinderliter Tool Company Division, Tulsa, Oklahoma, producers of oil field well head equipment and lubricated plug valves. Garber has been succeeded as general manager of American-Fort Pitt Spring division, manufacturers of railroad and industrial springs, by **H. A. Harrington,** former Works manager. Garber was graduated from Carnegie Institute of Technology in 1932 with a B.S. degree in works management. Harrington was formerly vice president, Good Roads Machinery Company of New York.

L. L. Garber

▸ **A. A. Dunaway** has been promoted to the position of assistant credit manager by Continental Supply Company. A graduate of Louisiana Tech, Dunaway went to work for Continental in 1936 in sales at Shreveport, Louisiana. In 1941 and 1942 he worked in the Houston credit office. He was in the armed service from 1942 to 1945 and has since served as district credit manager at Fort Worth and Tulsa.

▸ **Thomas E. Eagan** has been promoted to research metallurgist, The Cooper-Bessemer Corporation. In his new post, he will direct his full energies to furthering Cooper-Bessemer's experience in the field of nodular iron and other engineering metals for its own production needs, it was announced. Eagan's former laboratory supervision now becomes the responsibility of **W. R. McCracken** who will be in charge of Cooper-Bessemer's foundry research laboratories in Grove City, Pennsylvania. He also will supervise the materials control of Cooper-Bessemer foundry operations in both its Mount Vernon, Ohio, and Grove City, plants.

T. E. Eagan

John L. Morgan

J. D. McCammon

W. A. Meagher

▸ **W. A. (Pinkie) Meagher** has been appointed to the sales department of Superior Iron Works and Supply Company, Shreveport, Louisiana. Meagher joined Superior as sales representative last March.

Other appointees are: **J. D. McCammon,** who was named to the Dallas sales department of this machine and pipe fabrication plant in May. He is a graduate of Texas Technological College. **John L. Morgan** joined Superior's sales department in June. He has 17 years experience in the field.

▸ **Harry A. Dennis** has been appointed assistant sales manager for Graver Tank and Manufacturing Company, Inc. He will assist Willard M. Broxham, who directs Graver's sales. Dennis has been associated with Graver for more than 2 years as manager of sales, first for Graver's weldment division and later for the alloy division as well. He is a graduate in metallurgy from Penn State in 1942.

H. A. Dennis

▸ **Dr. Fred F. Fleischman** has been appointed sales engineer for Corning Glass Works' plant equipment sales department. Dr. Fleischman, who recently received his doctor's degree from Cornell University, will concentrate on the promotion and sale of Corning's pyrex brand glass piping to the dairy industry, it was stated. His headquarters will be in the company's main offices in Corning.

▸ **Raymond C. Gaugler,** president of the American Cyanamid Company, was elected vice president of the Manufacturing Chemists Association at a recent meeting. He succeeds **Leonard T. Beal** who retired from the post. Gaugler has long been an active member of the Association. Purpose of the group is to promote the interests of the chemical manufacturing industry in this country.

Wolfe

Struble

Mowry

Payne

Lane

Braswell

Link

▸ **A. McW. Wolfe** was recently elected vice president of the American Meter Company, Inc. A graduate of Johns-Hopkins University, Wolfe joined American Meter in 1919. He was named manager of the Boston factory in 1945.

D. Clark Struble has been named vice president — purchasing. An American Meter employee since 1928, Struble has been general purchasing agent since 1946. **E. J. Mowry** has been named personnel director of the company. A graduate of the University of Pennsylvania, Mowry joined American Meter Company in 1937.

Calvin N. Payne was recently made district sales manager of the Chicago sales territory of American Meter. Payne, a graduate of Princeton University, joined the company in 1921.

Val Link, Jr. has rejoined Westcott and Greis, Inc. division of American Meter Company at Lafayette, Louisiana. He left the company in 1946 to operate his own business. **Clay Braswell**, formerly at Odessa for Westcott and Greis, has been transferred to the company's Houston plant.

George M. Lane has joined the company's Odessa division. A former employee of Gulf Oil Corporation, he attended Pennsylvania State College. Another new employee is **Andy Sesack** who joined the division at Tulsa, Oklahoma. He is a graduate of Case Institute of Technology.

▸ **James H. Withers** has been appointed sales manager of the Charles Wheatley Company, Tulsa, Oklahoma. Connected with Charles Wheatley for the past year, Withers was previously with Manning, Maxwell, & Moore, Inc. He went to Tulsa four years ago, having been transferred from San Francisco.

James H. Withers

▸ **Herb Walther, Jr.,** development engineer for Dowell Incorporated in Tulsa, Oklahoma, has been placed in charge of the sales of cathodic protection products for retarding electrolytic corrosion of pipe lines and industrial equipment. The new head of the cathodic protection department was formerly working with the industrial division in Richmond, Virginia. He will continue working in some phases of the industrial division. Special representatives for the cathodic protection division have been established in Dowell's Chicago and New York offices. **William E. Bunting,** a member of the Dowell staff since 1944, has been named development engineer in Chicago. Bunting, a registered professional engineer, is a graduate of Wheaton College in Illinois. **Richard W. Stetson,** is now Dowell's cathodic protection representative in New York City.

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Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
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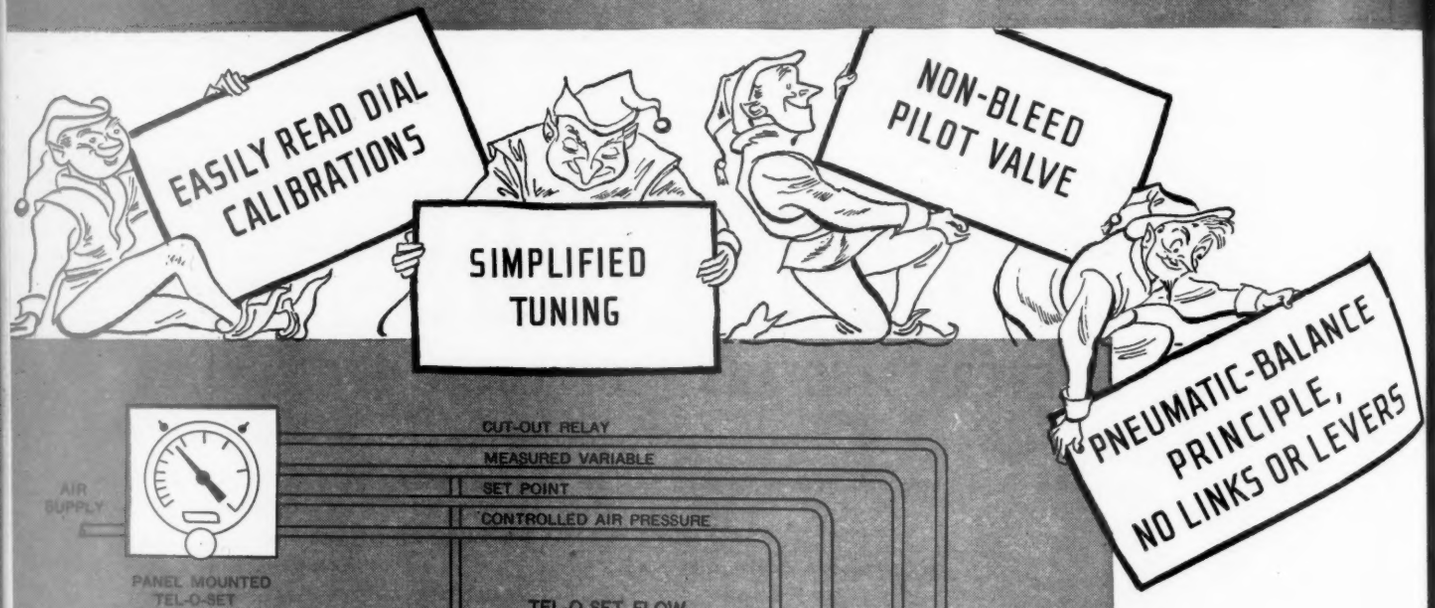
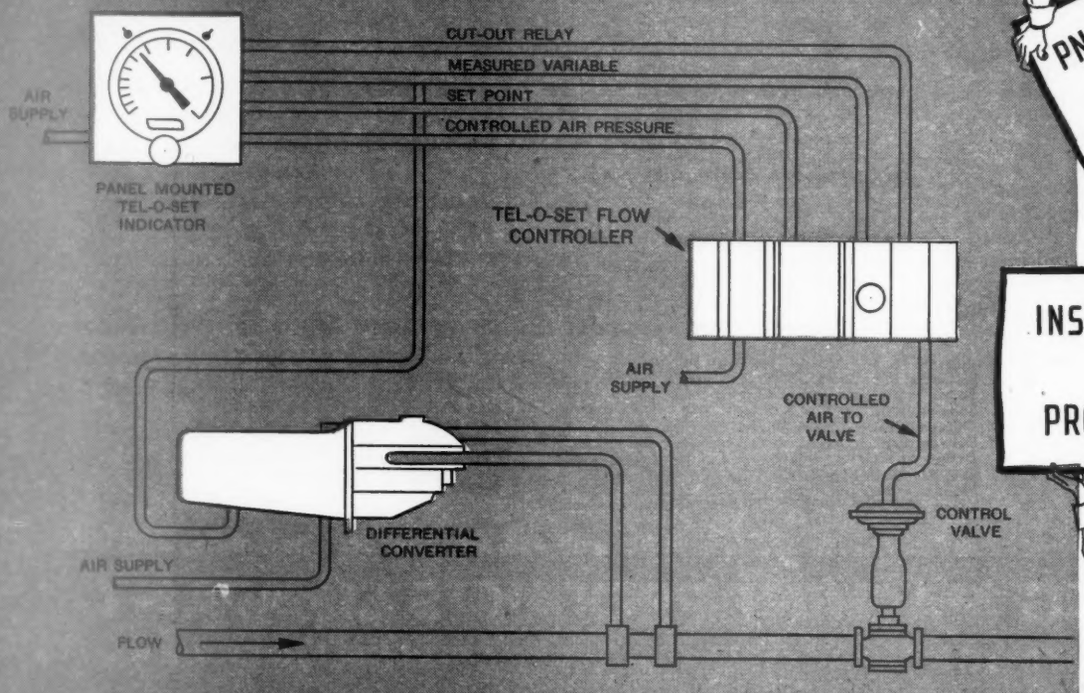
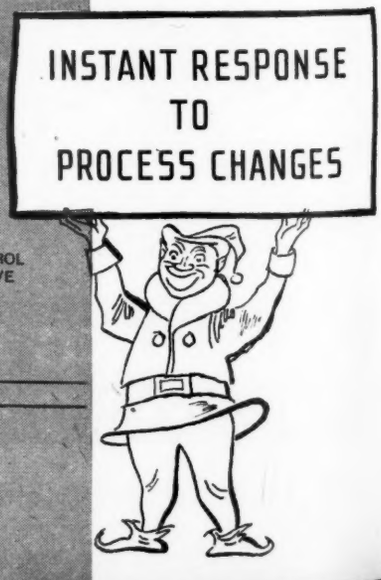
The New TEL-O-SET CONTROLLERS



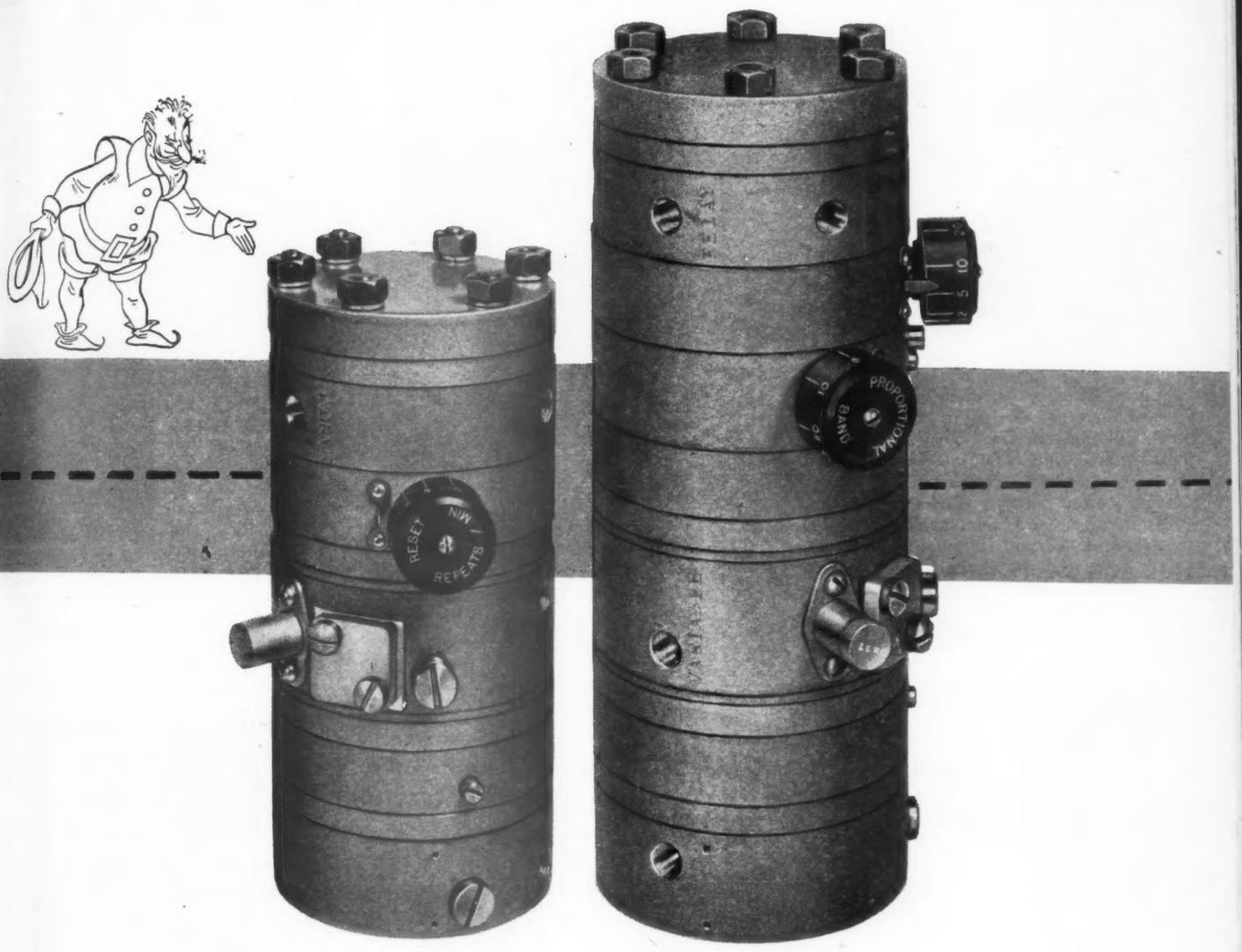


ENGINEERED CONTROL SYSTEM FOR FLOW

The Tel-O-Set Controller pictured in this diagram is one unit of the family, each part designed and built as an engineered, integrated loop.



to Process Control



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▸ **James C. Barney** has been appointed assistant manager of sales for the wire rope division of John A. Roebling's Sons Company. Barney's new headquarters are at the firm's home office, Trenton, New Jersey. He replaces the late **George B. Stoess.** Barney, who has been associated with Roebling for the past 26 years, began as a clerical assistant at the company's Los Angeles office. From 1925 until 1943 he served as office manager, and then was assigned to the California oil fields as sales representative.

J. C. Barney

▸ **Bruce R. Wright, John T. Odbert,** and **Michael J. Toth** have joined the steam speciality division of the V. D. Anderson Company. These engineers are heading up development work on new high efficiency purifiers, both internal and line types. Wright, a graduate mechanical engineer from Carnegie Tech, for 12 years prior to joining Anderson, specialized in the development and special application of high efficiency purifiers. Odbert is a graduate mechanical engineer from Cornell University and holder of a masters in chemical engineering from MIT, and has had over 20 years of broad engineering experience. Toth was graduated from Case Institute of Technology.

▸ **Lyle Goodman** will represent the Vulcan Rubber Products, Inc., in the Detroit area, **Garvice Hill** will cover Texas and adjacent territory, and **T. P. Connelly** will cover the Mid-Atlantic states for Vulcan. The company manufactures a wide range of rubber coated fabrics for industrial uses.

Chandler at The Hague

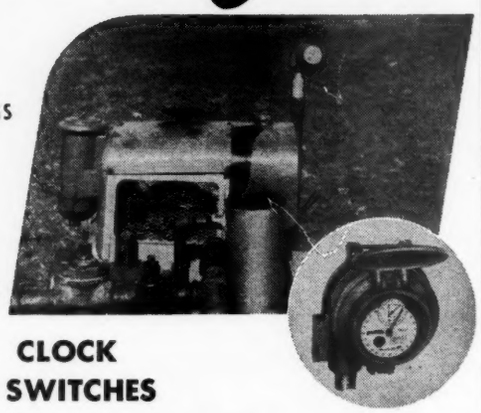
▸ **A. G. Chandler** (left), Reed Roller Bit Company London, England, representative, with his wife and Carl Von Elm of the Danish-American Prospecting Company, are shown at the Third World Petroleum Congress held recently in The Hague, Holland.

▸ **David H. Conklin** was appointed assistant director of sales of Du Pont's petroleum chemicals division recently with direct responsibility for district sales offices. **Joseph L. Stecher** will continue as assistant director of sales of the division in direct charge of products and services. It was announced at the same time that **Charles Wirth III,** manager of the New York Eastern district office of the division, has been made manager of wholesale sales in the Kinetic chemicals division of the company's organic chemicals department. Pending appointment of Wirth's successor, the New York office will be in charge of E. Hearn Simpson, petroleum chemicals sales manager.

▸ **A. H. Borchardt** has been elected a vice president of Worthington Pump and Machinery Corporation. Borchardt graduated from Columbia University with a Mechanical Engineering degree. After graduating, he joined Worthington's erecting and testing department. He became successively d raftsman, field engineer, and sales engineer, and in 1934, assistant vice president and manager of centrifugal pump application and sales division. Borchardt will be in charge of the pumping equipment line.

A. H. Borchardt

CHECK THROUGH WITH Enardo



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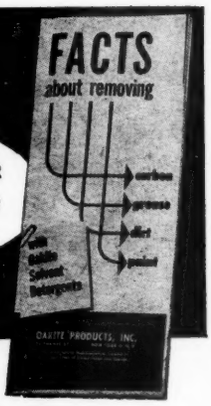

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Ludwig

Lobdell

Hancock

Hill

C. F. Ludwig has been named assistant manager of Lane-Wells Company's Pacific Coast division. Former vice president and manager of the Canadian company, Ludwig joined Lane-Wells in 1937 as a shooter, and has been a superintendent of districts throughout the company.

Replacing Ludwig will be **Lee J. Lobdell,** who has been appointed vice president and manager of the Lane-Wells Canadian Company. A Lane-Wells employee for 14 years, Lobdell is a former student of Providence College, Rhode Island.

Ray A. Hancock, previously assistant Pacific coast division manager has been transferred to Oklahoma as assistant Mid-Continent division manager. A graduate of the University of California, Hancock joined Lane-Wells in 1938.

Robert C. Hill has been employed by Lane-Wells Company as Los Angeles district electrolog engineer. A University of Colorado graduate, Hill originated and was head of the electronic department of Eastman Oil Well Survey Company prior to joining Lane-Wells.

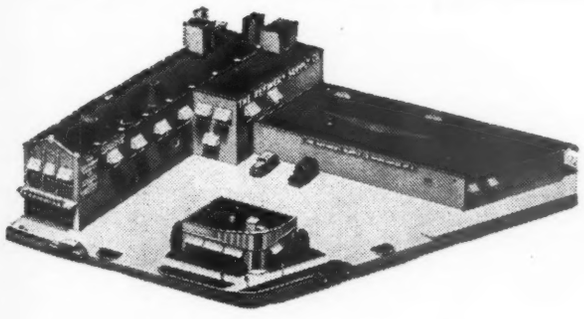
F. L. (Lee) Rathert has been appointed sales agent for Web Wilson Oil Tools, Inc., at Farmington, New Mexico. His address is Box 96, telephone 285-J; or in care of Farmington Supply Company, telephone 735-W.

C. S. White has been named manager of Dearborn Chemical Company's Eastern division with headquarters in New York. White, formerly manager of the Eastern division water treatment department, replaces the late Herbert J. Cornell who passed away on July 13. Cornell was a vice president and director of Dearborn and a veteran of 46 years of continuous service with the company.

L. V. Steffey has been transferred to the Lane-Wells division office in Oklahoma City as assistant to the division manager. In this capacity he will assist in the supervision of operations, sales, and general administration of the Mid-Continent division. Steffey has been with Lane-Wells for 13 years. **Luther C. Thaxton,** formerly of Oklahoma City, will take over the post, vacated by Steffey, of Illinois district superintendent at Olney.

W. Clifford Mumford, Worthington Pump and Machinery Corporation, has been named as manager of the vertical turbine pump sales division. Mumford joined Worthington in 1938 at the Holyoke, Massachusetts Works, and advanced successively from positions in the machine shops and erection department to the vertical turbine pump sales division. Since 1946 he was assistant to the late Frank Kemp, and has been acting manager of the division since Kemp's death. **Fenmore E. Dunn,** formerly consulting sales engineer, has been named assistant manger of the vertical turbine pump division. Dunn has been associated with Worthington since June, 1950. He graduated from the University of Cincinnati.

W. C. Mumford



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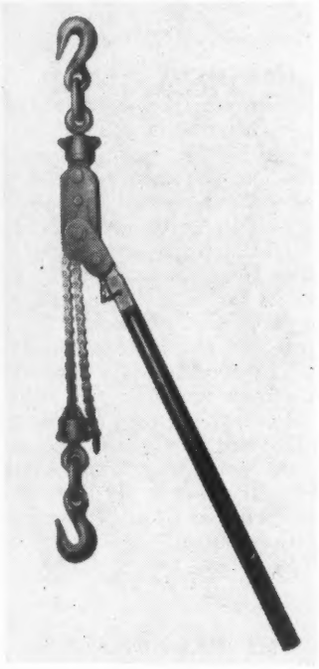
New Machinery and Supplies

Use reply card to procure promptly complete information and prices of products described here in brief.

Circle corresponding letter or letters on reply card.

(A) LOAD BINDER

A new load binder has been announced, which works on the ratchet hoist principle. It will take up or slack off a load chain any amount up to a full



20½ in.—or more if a longer chain is used in the binder. According to the manufacturer, advantage of the Hoist-Binder over eccentric type binders is especially important with "springy" loads where the binding chain or cable must be tightened by force through considerable distance in order to fully secure the load. Also, if a load settles in transit, the new unit may be tightened any amount without having to release the entire load to take a new "grab." Coffing Hoist Company.

Circle letter (A) on reply card.

(B) MUD PUMP

A new mud pump piston has been developed, which is claimed by the manufacturer to have many outstanding features. Some of these are: Replaceable lip piston rubbers, steel inner body providing rigidity, forged steel hub, easy assembling with end plate and positive lock. The piston can be renewed by installing new piston rubbers on the hub, and may be replaced at the rig without removing the piston from the rod. Harrisburg Sales and Service, Inc.

Circle letter (B) on reply card.

(C) FISHING TOOL

A magnetic fishing tool of the permanent magnet type has been developed, designed for "insurance runs" and for other fishing operations such as removal of bits, cones, bearings, sledge hammers, slips, and other hard-to-recover small junk. The tool is attached to the drill pipe or tubing by means of a threaded connection. It utilizes a reverse circulation system and a rotary shoe to loosen metallic junk in the hole and bring it within the tool's powerful magnetic field. This field is controlled and localized directly at the pole plate. No magnetism emanates from any other part of the tool. K & G Tool and Service Company.

Circle letter (C) on reply card.

(D) CLAY PELLETIZER

A new extruding machine has been designed especially for pelletizing clay. The pellets made by this 6-in. extruder are used in the production of high-octane gasoline and other petroleum products. Essentially, the machine consists of a specially designed screw contained in a steel cylinder. The screw is bored for coolant circulation, and the cylinder, has a hinged head at the discharge end, which supports the pelletizing die and cut-off mechanism. The drive is by electric motor through a double reduction gear drive. Farrel-Birmingham Company, Inc.

Circle letter (D) on reply card.

(E) GAS DETECTOR

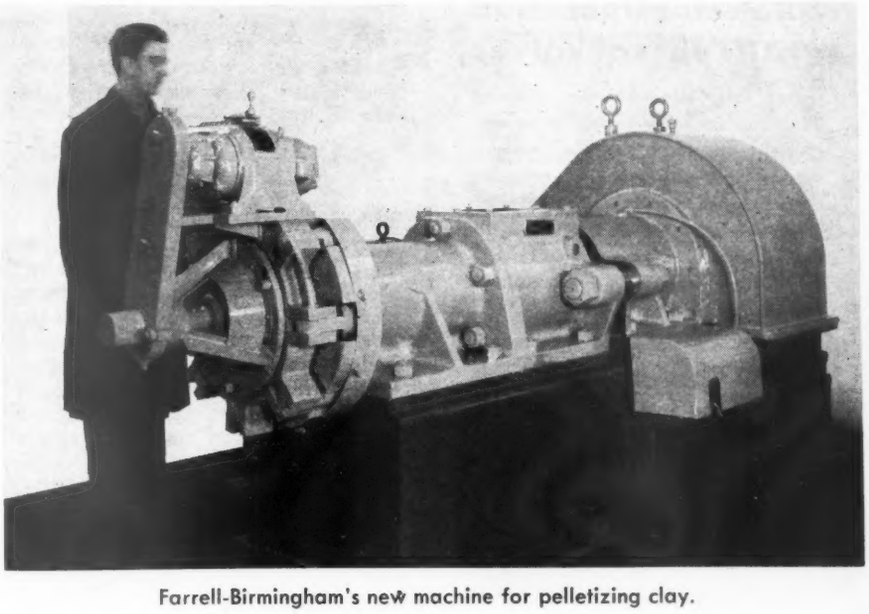
A new type semi-portable gas detector with siren alarm for use of geologist and safety engineers in continuous tests for hydrocarbon show in drilling wells, has been placed on the market. Called Rigtector, the instrument is designed to sound an alarm when either gas or other hydrocarbon vapors come from the well head. No flow pump or air aspirator bulb are required, but a simple swage is inserted between the well head and the shale shaker. The actual percentage of the lower explosive limit is measured and the alarm indicator may be set for any predetermined explosive percentage. It is operated by self-enclosed car storage battery. Atlas Exploration Company.

Circle letter (E) on reply card.

(F) RELIEF VALVES

The Guiberson Corporation has recently put on the market its new tubing swab overload relief valve. Factory-set to recover a predetermined column of fluid, the valve opens when more than the desired column is above the swab and closes when the column drains down to about two-thirds of the opening load. Original settings are accurate to within 70 ft of the fluid height specified. The Guiberson Corporation.

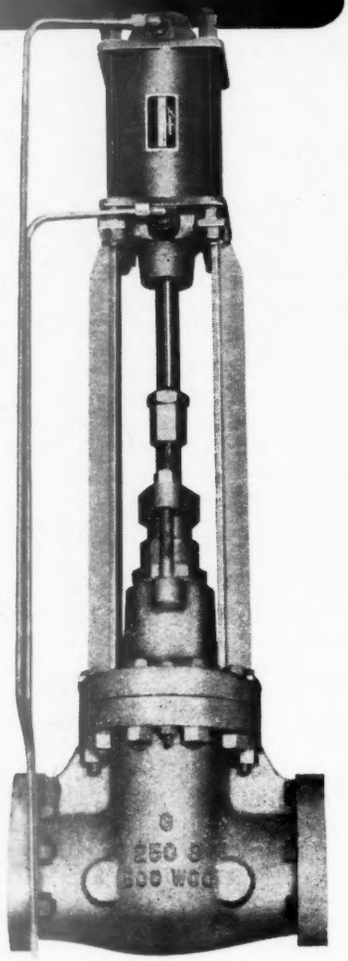
Circle letter (F) on reply card.



Farrell-Birmingham's new machine for pelletizing clay.

Ledeen

VALVE ACTUATORS



For Power Operation of All Types of Valves

Ledeen Valve Actuators are particularly adaptable for labor saving, or remote control of inaccessible valves. They can be adapted to any make, size, and type of valve to operate against any line pressure—for any fluid medium—with any pressure. Can be arranged for on-and-off, or positioning service. Positive in action, economical in cost

Write for Bulletin 512

Ledeen Mfg. Co.
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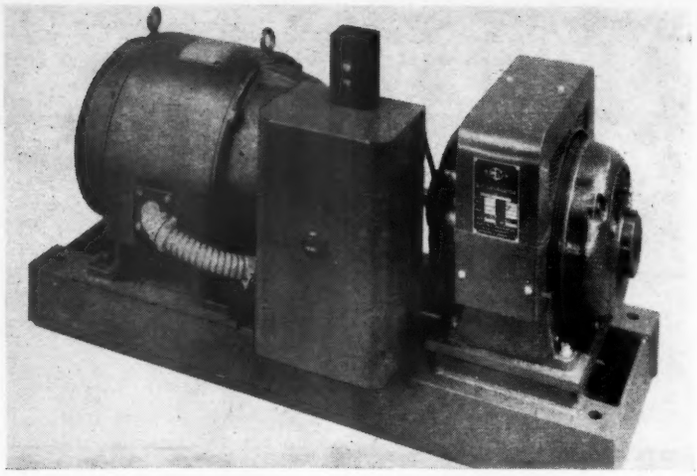
Los Angeles 15, Cal.



Latest motor generator set built by Electric Machinery.

(G) MOTOR GENERATOR

Used to convert 60 cycle current to 180 cycle and 360 cycle frequencies, is this new mono-coil high frequency motor generator set built by Electric Machinery Manufacturing Company. This equipment finds its greatest use in plants using high-cycle automatic electric hand tools such as grinders and buffers. These sets are self exciting and have built-in voltage regulation that automatically compensates for fluctuations in voltage to the load. Electric Machinery Manufacturing Company.

Circle letter (G) on reply card.

(H) CENTRIFUGAL PUMPS

A new line of general purpose centrifugal pumps has been announced by Economy Pumps, Inc., Division of Hamilton - Thomas Corporation. Designated as Type SCC, the new pumps are light in weight, easy to handle, install, and mount. Claimed to be an extremely adaptable pump, the new units are well suited for any small pump application such as small cooling towers, domestic water supply, hot water heating systems, and lawn sprinkling. They are also well adapted to booster and process pumping, and sewage or stock pump packing gland water supply. The SCC pumps are of close coupled type. Economy Pumps, Inc.

Circle letter (H) on reply card.

(I) CHAIN VISE

Disassembling, repairing, or connecting roller chain is now simplified by the use of the new Baldwin-Rex chain vise, recently announced by Baldwin-Duckworth division of Chain Belt Company. The vise makes it possible to take apart single or multiple strand roller chain in a few minutes with ease. The chain vise is made of forged steel with specially shaped jaws for adapting to various chain sizes. Approximate adjustments are made before the chain is inserted, permitting rapid clamping. Chain-Belt Company.

Circle letter (I) on reply card.

(J) GAS DUST ALARM

An instrument known as a gas dust analyzer, recorder, and alarm has been developed by the General Power Plant Corporation. The instrument is designed to record the amount of total suspended solids or dust particles in gas streams such as blast furnace gas lines, fly-ash in boiler smokestacks, effluent of process stacks for paper, pulp, and cement mills in grains per cubic foot. The analyzer and alarm were developed in 1950. The recorder is a special electronic circuit that measures the difference in output between two photoronic cells. One cell receives the light directly from the energizing lamp, while the second cell receives its light through the gas being analyzed. General Power Plant Corporation.

Circle letter (J) on reply card.

(K) JET PERFORATOR

McCullough Tool announces a new, improved flexible glass jet perforator. With over 1/3 less explosives, this new perforator is said to increase production in oil wells. More power with less explosives is particularly applicable in small pipe where more power is needed, as oil operators had formerly hesitated using the maximum safe charge of explosives in fear of damaging the casing.

Circle letter (K) on reply card.

(L) ENCLOSED MOTOR

A 10-feature totally-enclosed motor for explosion-proof requirements has been developed by U. S. Motors, made in capacities from 3 to 75 hp. Features incorporated include: Sealed terminal, elongated spark-arresting bearing sleeves, streamlined housing, hi-draft ventilation, removable cover, split hub fan, normalized castings, lubri-flush bearings, asbestos-protected windings, and solid, centricast rotor. Being completely sealed, this motor gives protection against external hazards, preventing instrusion of abrasives, etc. U. S. Electrical Motors, Inc.

Circle letter (L) on reply card.

(M) LIFT TRUCK

Supplementing its line of fork lift trucks in capacities from 2000 to 6000 lb are the new pneumatic tire models FPB20-24 and FPB20-15 fork trucks now being manufactured by The Buda Company. Features of Buda's models FPB20-24 and 15 fork trucks include: Carriage mounted on patented adjustable side thrust rollers to eliminate wear; extra strength and self-aligning mast; single lever two speed forward and two speed reverse gear shift, complete compliment of gauges and switches on full front vision instrument panel, and quick change heavy duty clutch. Powered with a 4 cylinder, 61 cu in. displacement engine, the Buda pneumatic tire fork lift trucks are available in five standard masts with a lift of 72, 84, 108, 114, and 120 in. The Buda Company.

Circle letter (M) on reply card.

(N) PORTABLE DERRICK

Precision electrical gages help to insure that Oil Well Supply Company's new 133-B portable derrick is sufficiently rugged for strenuous drilling service. The testing began on the derrick, when it was gradually raised from a horizontal position on the substructure as a gas engine set the draw-works spool to work lifting the huge structure. A network of wires connect highly-stressed members of the derrick with the strain recording equipment located on the ground. Each long wire is connected with a strain gage consisting of a short wire glued to the 'member' at the point of stress. During the period of elevation electrical current flows from the recording equipment on the ground into the strain gages in the members under strain. The resistance to this flow changes in the short wire as the strain varies and is so recorded.

Circle letter (N) on reply card.

(O) LAB MICROSCOPES

Ball bearings and rollers throughout the focusing system are one of the features of a new line of laboratory microscopes now in production at Bausch and Lomb Optical Company. Called Dynoptic Labroscopes, the new instruments also feature a low position fine adjustment and a mechanical stage with low controls that enable the operator, after setting the coarse adjustment, to rest his hand on the table and manipulate the other controls in a relaxed position.

Circle letter (O) on reply card.

(P) TEMP. INDICATOR

Southern Oxygen Company, Inc. has added Tempil° temperature-indicating products to the lines of welding accessories it distributes.

Tempilstiks°, Tempilaq° and Tempil° Pellets,—which provide means of determining correct temperatures in preheating for welding, stress relieving, tempering, and other heat-dependent operations—will be stocked at Southern Oxygen's 14 district offices.

Circle letter (P) on reply card.

"RCA MICROWAVE SAVED US $36,500... and cut out line maintenance, too!"

... says Chief Engineer Gladman Upchurch, Arkansas Game and Fish Commission.

Chief Engineer Upchurch (right) gives message to operator for general broadcast to all game wardens via Arkansas's RCA Microwave relay and 2-way radio system.

Twenty-five miles of costly pole-line construction, easements, and maintenance were eliminated by an RCA microwave link in the 2-way radio system recently set up by the Arkansas Game and Fish Commission.

Radio signals are beamed from capitol dome 15 air miles by RCA Microwave to a transmitter and relay station atop Chenault Mountain. From here state-wide FM 2-way radio contact is maintained with several outlying fixed stations and with 175 mobile stations in autos, trucks, and jeeps of far-ranging game wardens . . . *all at a saving of $36,500 and with no pole-line maintenance.*

Are you missing a bet on RCA Microwave? Do *you* have a problem maintaining communications through wind, sleet, and falling trees? RCA Microwave is the answer. Eliminates pole lines, easements, line maintenance, storm outages. Costs less per mile for comparable capacity. Signals travel by radio beam, span up to 35 miles. Repeater stations relay signal over mountains and valleys, operate unattended for months. System has channels for voice, supervisory control, teleprinter, 2-way radio, other circuits. So *dependable* it's used by telegraph and power companies, highway commissions, others. Get full story. Mail coupon . . . *today!*

RCA ENGINEERING PRODUCTS
Dept 127U, Camden, New Jersey

Please send me, without obligation, full story on how new RCA Microwave can give efficient, all-weather communications without pole lines, easements, or line maintenance.

Name_____

Title_____

Firm_____

Address_____

RCA RADIO CORPORATION of AMERICA

(Q) RING PACKING

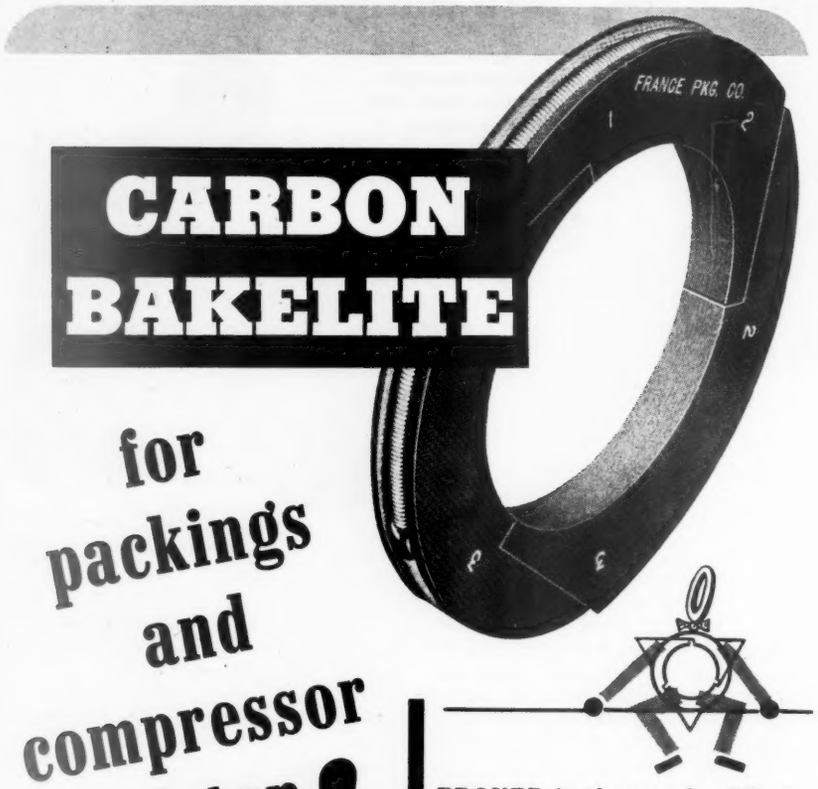
A new automatic ring packing called "Uneepac" has been developed. It is a molded packing and each ring is a complete, self-contained packing unit. It is designed for maximum sealing efficiency in minimum packing depth so stuffing box sizes can be reduced. No follower or header rings are needed. Each ring centers itself on the preceding ring. In service, each lip is always exposed to fluid pressure. This provides positive sealing and, as Uneepac does not depend on gland pressure for sealing, friction is reduced and there is less wear on both rod and packing. Uneepac is offered in various compositions to suit different services. Johns-Manville.

Circle letter (Q) on reply card.

(R) SIGNAL SWITCH

A float-operated signal switch device or fuel cut-off designed to operate on pressures from vacuum to 450 lb has been developed. Re-developed from a signal switch device marketed first in 1948, the new unit, designated as Levalarm EA-10 is heavier and embodies improved construction features. As a signal switch it is used to set off warning signals such as bells, sirens, or lights when liquid levels in small boilers or various types of tanks reach predetermined low or high points. Or it can be used as a fuel cut-off for low water. In water columns the levalarm float lever is inserted into alarm valve opening.—Reliance Gauge.

Circle letter (R) on reply card.



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(S) DRILL PIPE

Spang-Chalfant Division of The National Supply Company, announces Spangweld drill pipe, a new product on which a welded connection is employed between the tool joint and the upset ends of the drill pipe. The newly developed Spangweld drill pipe will minimize operating costs, it is asserted. Low "per foot" initial cost and recognized long life, will provide economical operation over an extended period, the company reports. Concentrated electric induction heat treatment of the weld relieves any residual stresses. Machining operations remove upset and weld flash inside and outside. Magnaflux inspection and hydrostatic tests are applied to every length of Spangweld. National Supply Company.

Circle letter (S) on reply card.

(T) HOOK—BLOCKS

A new line of Ideal hook-blocks, designed to effect maximum saving in vertical derrick space, is announced. The new hook-block is a combination traveling block and spring-loaded hook and connector, which is built in three sizes with working capacities of 90, 140, and 200 tons. It may be used as a hook to support the swivel bail directly or, if the operator prefers, the drilling string may be supported by the elevator with elevator links connected to the hook link support. All bolts, nuts, pins, and grease fittings are completely recessed in order to eliminate dangerous projections. National Supply Company.

Circle letter (T) on reply card.

(U) REMOTE MEASUREMENT

A new piece of equipment has been designed for the basic purpose of measuring tension, weight, or tractive loads remotely. It is electro-mechanical in design and is now equipped with oversize selsyn motors for added torque and increased dependability. To the manufacturer's standard traction dynamometer, has been mounted a ball bearing type selsyn motor, connected by a rubber covered cable to a repeater motor housed in a metal cabinet. Loads imposed on the dynamometer transmitter are read on the repeater station at distances up to 400 ft away. W. C. Dillion & Company, Inc.

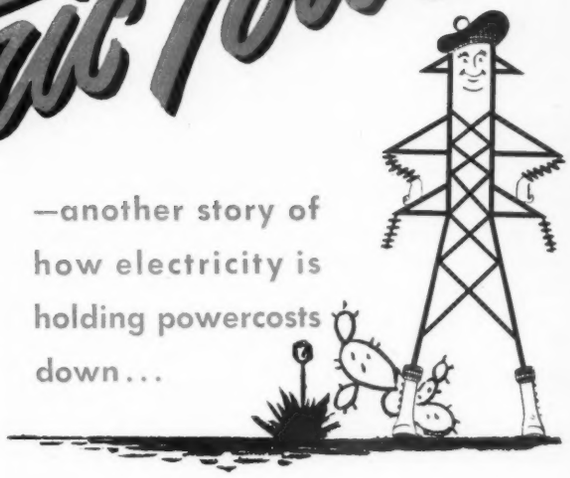
Circle letter (U) on reply card.

(V) SLIDE RULE

A new slide-rule, designed to assist those engaged in cathodic protection of pipe lines, has been developed, called a magnesium anode cathodic protection guide. With pipe size and coil resistivity known, the slide-rule gives required magnesium anode size and life, length of pipe protected, and current output. The slide-rule magnesium anode cathodic protection guide will be sent free to those engaged in cathodic protection work. American Smelting and Refining Company.

Circle letter (V) on reply card.

West Texas Pumps with Electric Power



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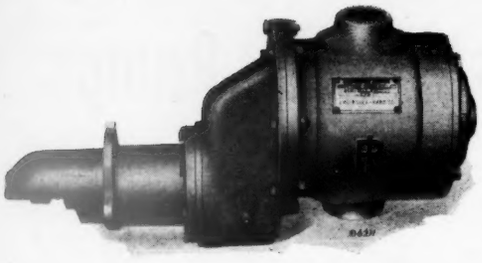


Ingersoll Rand starting motor for gasoline and diesel engines.

(W) STARTING MOTORS

Two new air starting motors for cranking gasoline and diesel engines are announced by Ingersoll-Rand Company. They are expected to be used in the lumbering, petroleum, mining, marine, heavy construction and power fields. They are designed for cranking diesel and gasoline engines with piston displacements up to more than 3500 cu in. Although normally operated by compressed air, they are also suitable for operation on natural gas where available at sufficient pressure.

Circle letter (W) on reply card.

(X) DUAL FUEL UNIT

A new engine equipped for dual fuel use was announced recently. The power plant will operate on suitable gas when it is economically available, requiring but a small "pilot" charge of fuel oil to ignite the gas charge. If the gas supply fails or is not available, the engine will operate on straight diesel fuel oil as a full diesel unit. A simple moving of the selector lever changes the engine from a gas unit to a diesel unit. General Motors Corporation.

Circle letter (X) on reply card.

(Y) SAFETY LOCKS

Beaver Pipe Tools, Inc., announces the Model "E" lightweight economy model is now equipped with a safety switch lock. The Power Units C1 and C2 are also protected with safety switch locks. The safety switch lock is an important device protecting workmen, as well as machine, against possible injury. Automatic, the safety switch lock makes it impossible to start the Model E unless chuck wrench has been removed from the chuck and placed in its holder. Beaver Pipe Tools, Inc.

Circle letter (Y) on reply card.

(Z) METALLIC TUBING

Republic Steel Corporation is offering a new standard, galvanized electrical metallic tubing, covered by a highly corrosion-resistant polyethylene coating. The new product is designed especially for locations where wiring and insulation are exposed to corrosive or chemically active vapors or liquids. The Polyethylene coating is not affected by concentrated caustic soda, nor by dilute acids or concentrated HCl at 100 C (212 F), boiling point of water. It is dissolved by several solvents at 70 C or above, such as exylene, toluene, amyl acetate (banana oil) petroleum etherturpentine and lubricating oils. Republic Steel Coroporation.

Circle letter (Z) on reply card.

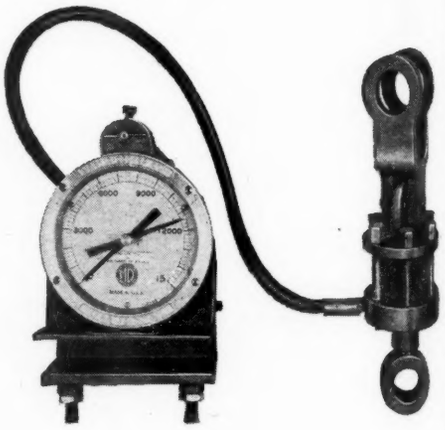
(AA) THRUST WASHERS

Recently developed are the new bronze replacement split thrust washer, used to eliminate dismantling of machines or equipment for thrust bearing replacements. The washers are simply slipped over the shaft and locked with a safety key. These split thrust washers are designed for on-the-spot repair and more economical operation. Saginaw Bearing Company.

Circle letter (AA) on reply card.

(AB) TORQUE INSTRUMENT

A tong torque instrument was recently developed that eliminates overtonging, which results in pulled and distorted threads, and running collars too loosely, allowing the joints to work,



causing cracks and washouts. This instrument, which has been developed for measuring torque when making up and breaking out drill collar joints, is also useful for torque measurements on pipe and casing joints. It is now possible to accurately measure the cable pull when making joints with standard tongs. A clevis has been designed to fit the tong handle so that the cylinder can be attached or removed simply and easily without any alteration to the lever. The regular cable, rope, or chain can be connected to the other end of the cylinder. Martin-Decker Corporation.

Circle letter (AB) on reply card.

Only Thorough Engineering and Adequate Sizing Can Give You Pritchard Quality!

New Pritchard Type "B" QUINTAIR*

Air Cooled Heat Exchanger

Pritchard *quality* means a lot when it comes to selecting air cooled heat exchangers. Take Pritchard's Type "B" QUINTAIR* for example. All parts requiring attention are readily accessible and easily serviced. Thoroughly engineered for long life and operating economy—adequately sized for top performance under the most exacting conditions—the Pritchard Type "B" QUINTAIR* can handle one or several different heat loads in a single compact unit. Whatever your cooling problem, it will pay you to investigate the Pritchard Type "B" Air Cooled Heat Exchangers.

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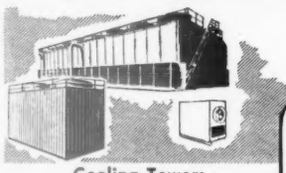

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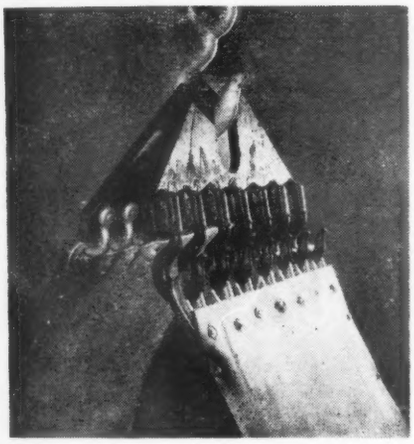
(AC) RADIO HOUSINGS

Accessibility of 15-in. Motorola F.M. 2-way mobile radio housings has been increased by the addition of a new "split-housing" feature now being introduced by the company. New 30 and 60-watt mobile sets are now being shipped with the new design that makes mounting possible in positions where the drawer-type housing could not be installed because chassis withdrawal would have been impossible. Because of the split-housing feature the chassis can be lifted out of the lower section of the housing. Only about 1-in. frontal clearance is necessary for unlocking the unit to remove the upper housing section and then lifting out the chassis drawer. Motorola, Inc.

Circle letter (AC) on reply card.

(AD) NEW SLING

As pipe sizes and weights continue to increase, the problem of handling pipe from the tip of the tractor boom into the ditch also takes on greater proportions



for contractors and ditch men. There are many good slings on the market, but a new one has been introduced that has attracted attention because of its light weight and certain new design features. It is known as the "Knudsen Heavy Duty Sling." Tested to 90,000 lb without breaking, the belt structure has taken all extreme loads in the field. One man can handle the heaviest sling with ease, the manufacturer states. There are no protruding bolts to catch on anything. The total weight of the largest sling is only 108 lb. Vic Knudsen.

Circle letter (AD) on reply card.

(AE) NEW TYPE ALLOY

The International Nickel Company has announced the development of an alloy for use under conditions of high temperature and corrosion. The new alloy, trade-named "Incoloy," contains about 35 per cent nickel and 20 per cent chromium, with the balance iron. It is produced in most standard rolling mill forms, including sheet, strip, rod, wire, and tubing. This alloy is designed for many purposes now served by some of the company's older alloys, which run to more than 70 per cent nickel. International Nickel.

Circle letter (AE) on reply card.

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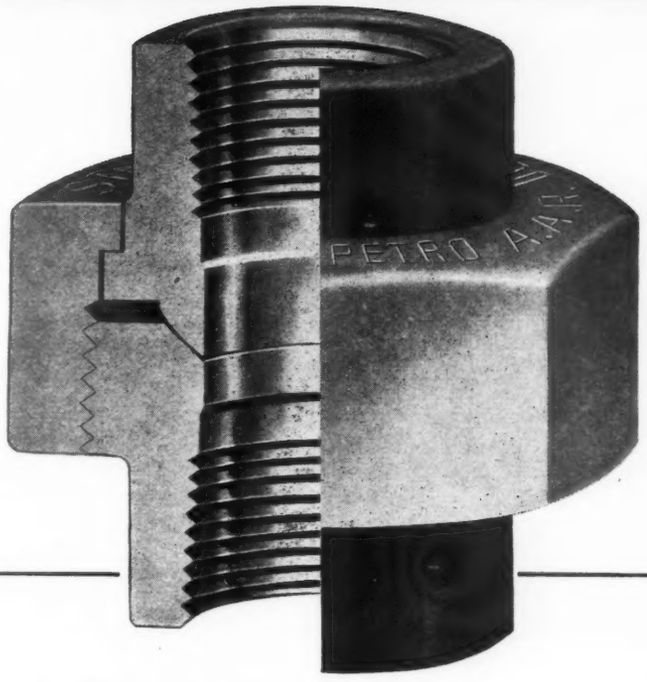
PETRO

REG. U.S. PAT. OFF.

FORGED STEEL UNIONS



PETRO A.A.R.
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Unions being precision made and tested on air under oil at the time of manufacture assure a tight seal in seats and threads thereby giving continuous trouble-free performance. Maintenance men that use PETRO Unions know this careful checking and the many features built into PETRO combine to do the JOB obediently.

HANDLE-BAR 4000 TEST
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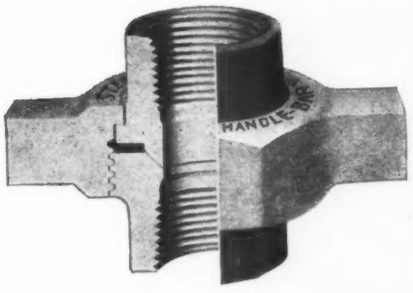

HANDLE-BAR Unions are precision built with features that insure trouble-free performance. Hot forged from A. I. S. I. 1023 killed steel. Modified Acme threads in the nut. Nut threads permanently lubricated with Udylited Cadmium to permit ease in making and breaking. Steel to steel or bronze to bronze seats. Furnished Black or all Rust-proofed. Pressures to 3000 lbs.

Write Dept. P for illustrated catalog or refer to listings in Composite Catalog pages 3140-3141, Refinery Catalog page 538, and Chemical Engineering Catalog pages 980-981.

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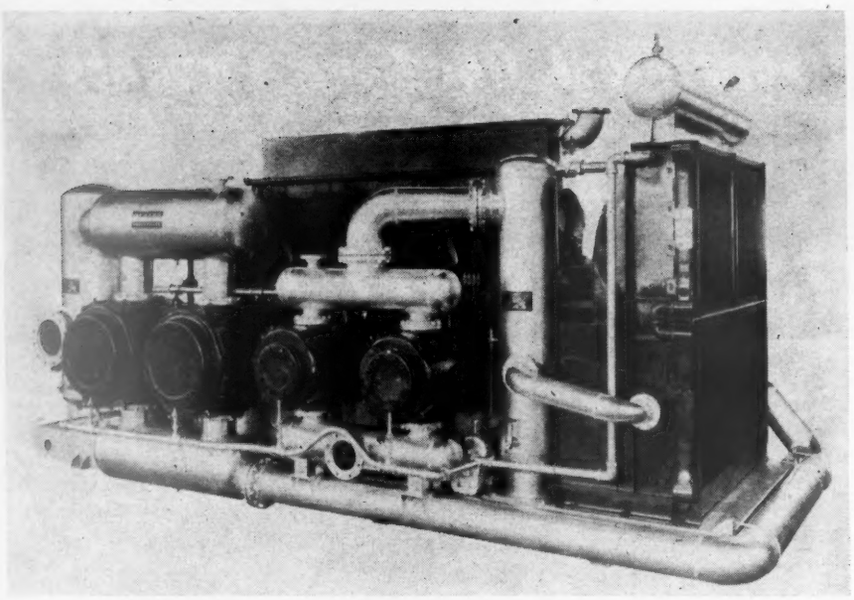


Packaged compressor plant developed by B. Beaird Company.

(AF) CUPCASE THERMOMETER

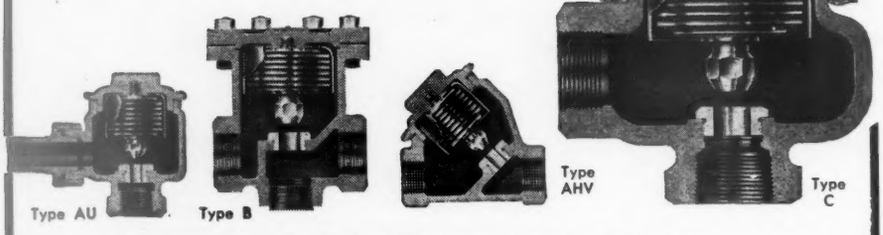
A new cupcase thermometer, narrow enough to fit into 2-in. gage pipes in oil storage tanks has been developed. It is designed for use in the oil industry where temperature is an important factor in determining the volume of oil at the time of sale. As oil temperature varies from place to place within storage tanks, accurate temperature readings of the stored volume of petroleum are essential. The new thermometer has a cup capacity of 100 milliliters. The thermal inertia resulting from the new model's larger capacity provides greater resistance to temperature change as the thermometer is raised from reading depth and passes through varying temperatures at other levels. Weston Electrical Instrument Corporation.

Circle letter (AF) on reply card.

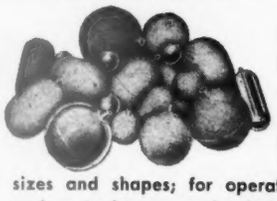
Nicholson Steam Traps

STOP WATERLOG LOSS

Due to Operation on Lowest Temperature Differential



Repeated comparafive tests by large trap users show that Nicholson traps operate on lowest temperature differential: 5° to 15°, depending on trap size and steam pressure. Production of cooking kettles, for example, has been increased as much as 30% because fast action of Nicholson traps keeps equipment full of live steam. They are specified for all apparatus where back-up of condensate causes corrosion or damage to thin gauges. 5 types for every application; size ¼" to 2"; pressure to 225 lbs.



HIGH-PRESSURE FLOATS — Stainless monel, steel, or plated steel. Welded. In all sizes and shapes; for operating mechanisms and as tanks or vessels. Quick delivery. BULLETIN 650.

BULLETIN 450 or Refinery Catalog

W. H. NICHOLSON & CO., 217 Oregon St., Wilkes-Barre, Pa.

(AG) COMPRESSOR PLANTS

Two new packaged compressor plants with more horsepower per pound than previous models, have been announced. They are the 330 hp 6 SVG and the 440 hp 8 SVG. New design has doubled the amount of available horsepower per pound. Incorporating the new Ingersoll-Rand SVG line of gas engine driven compressors, these packaged units are complete plants, including every component and control usually found in handling system, including scrubbers, piping, manifolds and cooling system, is gas-engineered for each plant to meet the particular operating conditions. J. B. Beaird Company.

Circle letter (AG) on rep'y card.

(AH) PURIFIERS

The first in a new line of low-cost purifiers has just been announced. This purifier is of the internal type and has a wide range of applications inside steam drums, flash tanks, evaporators, packed towers, bubble-cap towers, deodorizers, and stills.

Called the Anderson Hi-eF purifier, the unit is guaranteed by the manufacturer to deliver vapor with 1.0 ppm or less of total solids. The unit contains no moving parts. Furthermore, the new design eliminates the need for baffling in boilers and drums. The V. D. Anderson Company.

Circle letter (AH) on reply card.

(AI) POWER UNIT

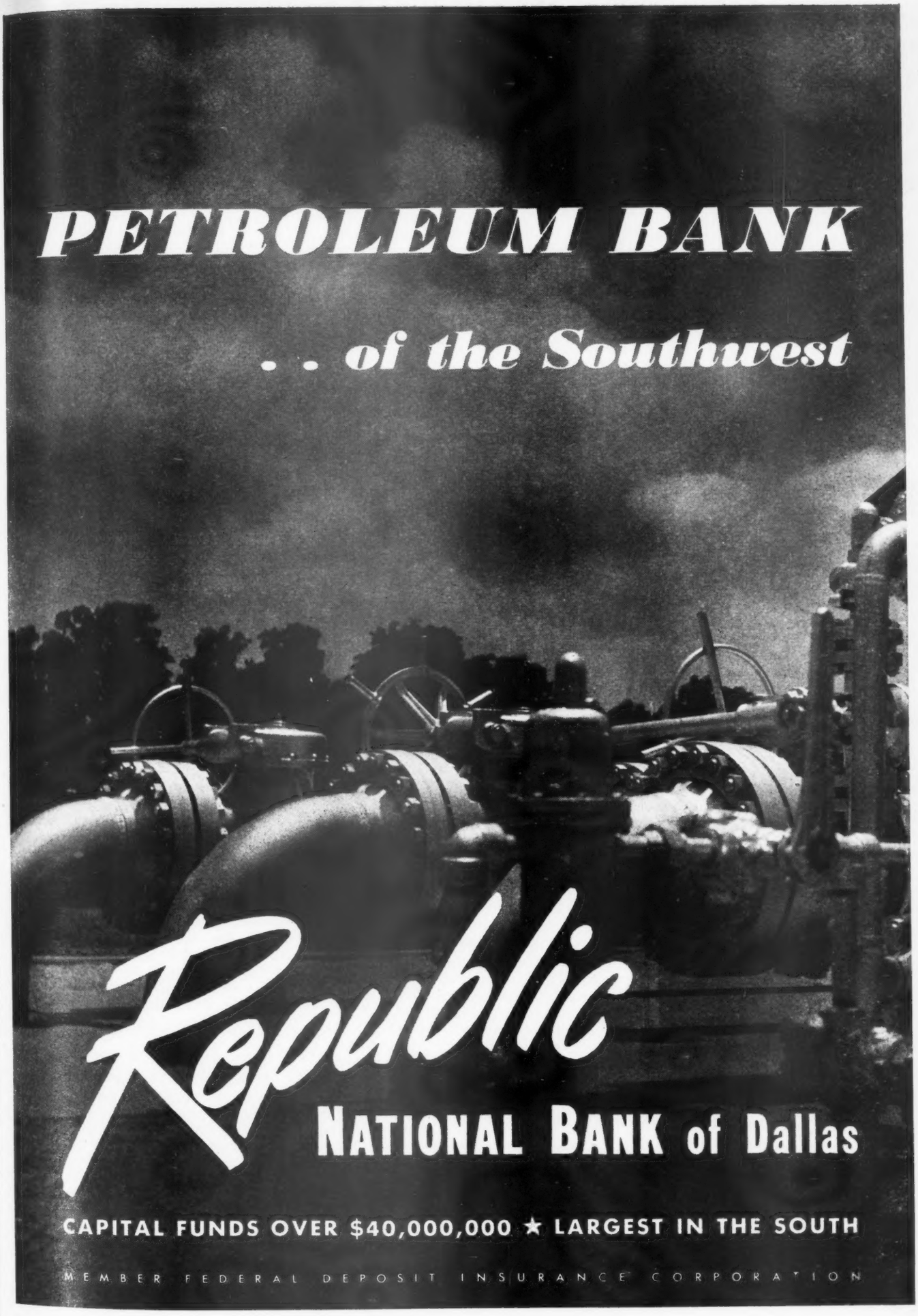
A new pack set power supply designed to increase the utility of the Motorola F.M. 2-way radiophone pack unit by making it convertible to semi-fixed or mobile application, while preserving the dry battery supply for portable operation is now being produced. A plug-in power connection and switching facilities on the pack unit permit transfer from internal dry battery power supply to an external power source. The power supply makes it possible to operate the pack set from either a 117-volt A-C or a 6-volt D-C primary power supply. Motorola Inc.

Circle letter (AI) on reply card.

(AJ) COPYING MACHINE

Introduction of a new, low-cost Bruning Copyflex machine, the Model 20, for making copies in all phases of business and industry, has been announced by the Charles Bruning Company. Because of its low cost, advanced engineering, and copy width, the new machine offers special value to both business and industry. Engineers, designers, and chief draftsmen will find it ideal for the medium volume production of prints from tracings, engineering drawings, and other large sized technical originals. The new Copyflex machine offers a 46-in. printing width with exposure speeds up to 95 in. per minute. Charles Bruning Company, Inc.

Circle letter (AJ) on reply card.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Publications will be sent free.

(AK) PRESSURE REGULATOR

A new 16-page illustrated bulletin-catalog describing applications, operating principles, and features of Grove Powreactor Dome regulators has just been released. These regulators are used extensively for controlling gas, liquids, and air at pressures up to 600 lb at temperatures up to 150 F. Connection sizes range from ¼ to 2 in. Utilizing the balanced pressure principle, the Powreactor Dome regulator derives its powerful equalizing force from the pressure loaded dome, reducing initial pressure to the desired delivered pressure. Grove Regulator Company.

Circle letter (AK) on reply card.

(AL) STEEL STRAP

A new booklet containing information on a new product, Expand-R-Strap is now available to the public. This steel strap was developed to hold insulation snugly around tanks, drums, pipe and other equipment that expands and contracts in circumference. The extra spring resulting from its corrugation enables Expand-R-Strap to stretch and contract to maintain constant pressure on the expanding and contracting unit it binds. A. J. Gerrard & Co.

Circle letter (AL) on reply card.

(AM) RATIO CONTROLLER

A new catalog describing the features of Fischer and Porter Company's automatic flow ratio control system is now available. The principle of operation is described as well as the fundamental reasons for improved ratio control. A list of typical applications is included.

Circle letter (AM) on reply card.

(AN) STAINLESS STEEL

A most complete and concise handbook on stainless steel is available from the Allegheny Ludlum Steel Corporation. The 120-page book is filled with diagrams, illustrations, tables, and charts. Comprehensive listings of analysis, properties, and characteristics of each type stainless steel guide the reader in specifying grades that will do particular jobs more efficiently. Clear and concise fabrication data will help speed production and cut waste. This Handbook of Stainless Steel has been rewritten and expanded to meet the needs of the rapidly-growing industry. About 40 types of stainless steel have been treated in this volume. Allegheny Ludlum Steel Corporation.

Circle letter (AN) on reply card.

(AO) DRILLING RIGS

Bulletin No. 381, just released by National Supply describes sectional drive groups incorporating Ideal-Gyrol fluid drive for Ideal consolidated drilling rigs. Showing arrangements of two, three, and four engine groupings from 250 to 700 hp capacity, the bulletin describes designs for main and secondary pump drives and discusses operating characteristics. Data on weights, dimensions of the sections, and details of construction and assembly are included.

Circle letter (AO) on reply card.

(AP) SAFETY VALVES

Otis Pressure has issued a new, eight-page bulletin on the entire line of tubing and surface safety valves it markets to oil and gas operators. The folder describes the purposes, operating principles, and design details of the valves, and illustrates typical installations. Included is information on the Otis Type X surface safety valve, the Type A valve for flow wings, which operates similarly to the Type X, and eight types of Otis tubing safety valves. Otis Pressure Control, Inc.

Circle letter (AP) on reply card.

(AQ) RUST PREVENTION

How a rust-control program—for preventing rust and removing rust — can contribute importantly to longer service life for petroleum equipment and reduced unit replacement and reconditioning costs, is the subject of a special service report available from Oakite Products, Inc., Under the general categories of salvage and maintenance operations, the report reviews specialized materials and methods for (1) simplified removal of rust, (2) prevention of rust under paint, and (3) prevention of rust on bare metal. Oakite Products, Inc.

Circle letter (AQ) on reply card.

(AR) GRINDING WHEELS

Mackling Company has published an 109-page book on its grinding wheels, which are manufactured in Vitrified and Resinoid Bonds in every size and shape for all grinding uses. The booklet is profusely illustrated with specification drawings, and contains a vast amount of tables. List prices on all items are carried, together with a list of good operating rules. One of the tables shows revolutions per minute for various grinding wheels to give peripheral speed in feet per minute; another gives the minimum diameters of spindles for wheels of various diameters and thicknesses operating at speeds up to 7000 peripheral feet per minute. The extraordinary number of tables and information contained in this book make it a book of great value. Mackling Company.

Circle letter (AR) on reply card.

(AS) CAR PULLER

A new catalog, recently released describes American Hoist and Derrick's complete line of electric car pullers and provides many suggested uses for this versatile piece of equipment. Only one man is needed to operate an electric car puller—on rail sidings, at loading docks, on piers, in mines or wherever the moving of rail cars or heavy equipment is necessary. There are three American electric car puller types—capstan, drum and continuous rope. The catalog describes each one, their applications and gives specifications as well.

Circle letter (AS) on reply card.

(AT) CHAIN DRIVES

A new bulletin entitled "Installation, Operation and Maintenance of Chain Drives and Conveyors" has just been published. Of great interest to all who design, install, maintain or operate chain drives and conveyors, this bulletin shows how to get the most service from sprocket chains. The text is short and to the point, and most of the illustrations show graphically the correct and incorrect ways of solving chain installation, operation and maintenance problems. Chain Belt Company of Milwaukee.

Circle letter (AT) on reply card.

(AU) FINISHING CEMENT

A folder is now out on a new type cement, which the manufacturer states insulates as it finishes. Called Powerhouse cement, it may be applied to either cold or hot surfaces of ducts, vessels, and equipment. It hardens due to hydraulic set; then dries without shrinkage cracks, to form a smooth, strong, resilient surface. One coat is sufficient for a smooth, monolithic surface. Baldwin-Hill Company.

Circle letter (AU) on reply card.

(AV) TURBINE PUMPS

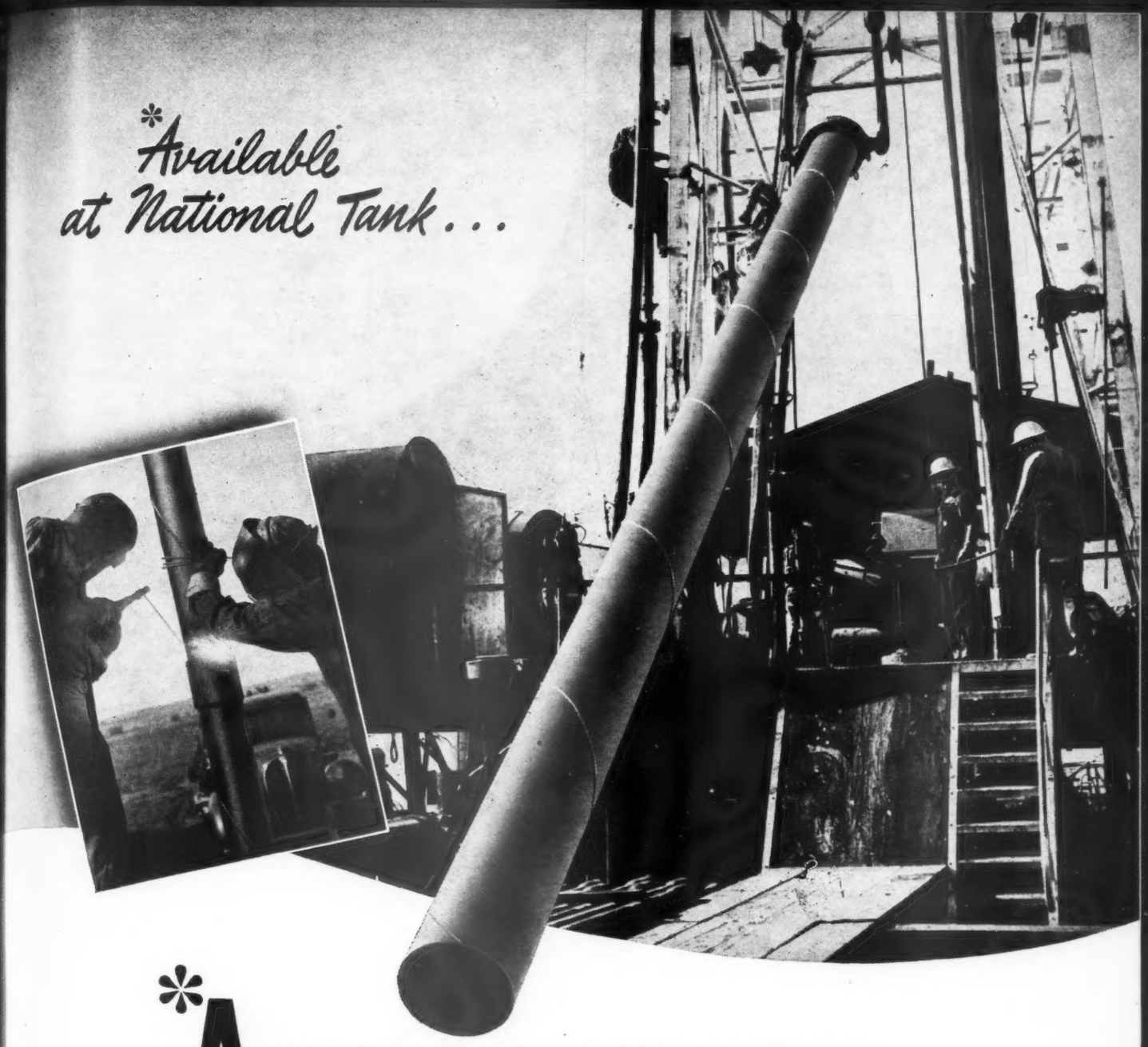
An eight page catalog which describes the vertical, turbine-type pumps was recently published. These pumps are particularly applicable to bulk liquid transfer, cooling tower, dewatering and similar services where suction is taken from an open source. Available in single- or multi-stage construction, with any desired column length, these pumps range in size from 6 to 30 in. for capacities to 15,000 gpm and pressures to 250 psi. Ingersoll-Rand Company.

Circle letter (AV) on reply card.

(AW) TUBING STEELS

Technical information of value to engineers and designers associated with equipment operating at elevated temperatures and pressures is presented in a new data card recently published. Known as TDC 102, it gives information on creep for a number of tubing steels. Creep stress data are given for rates of 1 per cent elongation in 10,000 and 100,000 hours at temperatures from 800 F to 1500 F for 16 popular carbon, intermediate alloy and stainless steels. The Babcock and Wilcox Company.

Circle letter (AW) on reply card.



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(AX) GLASS INSULATION

A new booklet entitled "Foamglas Insulation For Piping and Process Equipment" was published recently. This well illustrated 24-page booklet discusses the advantages of Foamglas, listing its properties, typical data for cold, intermediate, and hot applications, details for insulating tanks, ducts, removable covers, and tank heads, accessory materials, and prominent users, and distributors. Foamglas, the cellular glass insulation, is used as an industrial insulant. Tables in the new booklet, of great value, are those showing sizes and shapes of Foamglas available in pipe insulation, standard blocks, beveled lags, and standard curved segments, and recommended shapes and thicknesses. Pittsburgh Corporation.

Circle letter (AX) on reply card.

(AY) STARTING MOTORS

Two new air starting motors for cranking gasoline and diesel engines are announced by Ingersoll-Rand Company. They are expected to be used in the lumbering, petroleum, mining, marine, heavy construction and power fields. They are designed for cranking diesel and gasoline engines with piston displacements up to more than 3500 cu in. Although normally operated by compressed air, they are also suitable for operation on natural gas where available at sufficient pressure. Ingersoll-Rand Company.

Circle letter (AY) on reply card.

(AZ) CONCRETE MIXER

Now in production is a new Rex 6-S concrete mixer, built for fast production on jobs needing a 6 cu ft mixer. The water tank has been relocated to the top of the mixer to permit faster water entry, faster batching, more concrete per hour. It is now equipped with a "see-in" clear, unbreakable plastic check valve for elimination of guesswork in the water supply. Eliminating practically all service problems and costs, the new improved water valve can be completely overhauled (when required by wear) by simply replacing "O" ring. A new "one-arm" control for clutch and brake simplifies the operator's movements; speeds production. Chain Belt Company of Milwaukee.

Circle letter (AZ) on reply card.

(BA) TRANSMITTER

The Honeywell displacement type liquid level detector and transmitter is fully described and illustrated in a new specification sheet 417-1. This device is suitable for connection to any pneumatic receiver-indicator, recorder or controller to provide closer liquid level control than obtainable by conventional ball float buoyancy type controllers. Minneapolis-Honeywell Regulator Company.

Circle letter (BA) on reply card.

(BB) CHAIN DRIVE

A new catalog to assist in chain drive selection, has been published. The catalog has been compiled to offer a simple, quick means of determining interchangeability of various makes of roller and conveyor chains. Additional useful information is supplied, which is of value in determining the proper application of chain drives as a power transmission or conveying medium. Whitney Chain Company.

Circle letter (BB) on reply card.

(BC) STEEL TUBING

Technical data on tubing for the petroleum, chemical, pulp and paper, food and pharmaceutical processing industries is presented in a new eight-page illustrated bulletin recently published. The bulletin includes analyses and tables of physical and mechanical properties as well as application data for 20 popular carbon, alloy, and stainless tubing steels. Tubing from such steels is used in heat exchangers, condensers, boilers, conveying lines, and structural or functional parts of processing equipment where temperature, pressure, sanitation, or corrosive environments are importan considerations. Babcock and Wilcox Tube Company.

Circle letter (BC) on reply card.

(BD) PIPE COUPLINGS

Publication and distribution of its new catalog has been completed by the Wheeling Machine Products Company of Wheeling, West Virginia. The 24-page edition illustrates and describes the entire line of steel pipe couplings manufactured by the firm under its "X-L" trademark for the plumbing and oil field industries. In addition, it contains valuable trade information. Wheeling Machine Products.

Circle letter (BD) on reply card.

(BE) ROLLER CHAINS

A new catalog of stock roller chains and sprokets has recently been announced by Morse Chain Company. The catalog gives details on list prices, available sizes of type A, B, and C Morse stock sprockets, and pertinent information on stock roller chain from $\frac{3}{8}$ in. pitch to 2 in. pitch. Also included are data on drive selection, service factors, installation, and service. Morse Chain Company.

Circle letter (BE) on reply card.

(BF) TIRE CONSERVATION

Containing information on tire conservation, a new 8-page booklet has been published by The B. F. Goodrich Company. Some of the methods listed to get maximum service from tires are: Proper selection of tire for the job; correct inflation; correct loading and load distribution; correction of mechanical defects; proper care of tubes; regular rotation of tires, etc.

Circle letter (BF) on reply card.

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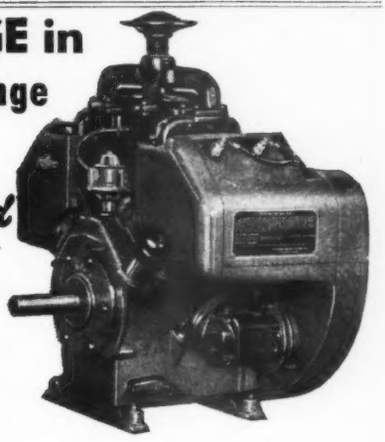

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MODELS		VE4	VF4	VP4D
Bore	inches	3	3¼	3½
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Displ. cubic inches		91.9	107.7	154
H.P. and R.P.M. range		15 at 1600	17.5 at 1600	26.8 at 1600
		21.5 at 2400	25 at 2400	31 at 2200
Net weight in lbs., Standard Engine		295	295	410

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(BG) PURIFIERS

An internal type purifier designed to remove virtually 100 per cent entrainment from vapor is described in a recently published 4-page, 2-color bulletin. The new purifier called the Anderson Hi-eF purifier, is reported to do an excellent job of high efficiency separation at a very low cost. This internal type purifier is recommended for installations inside steam drums, flash tanks, evaporators, packed towers, bubble-cap towers, deodorizers and stills. The folder contains dimensional drawings illustrating the use of purifiers inside two typical installations, steam drums and bubble-cap towers. V. D. Anderson Company.

Circle letter (BG) on reply card.

(BH) STEAM TRAPS

A new 32-page illustrated catalog has been released describing five types of thermostatic steam traps for pressures up to 225 lb. Also included in the booklet is information on 2 types of expansion steam traps for pressures to 250 lb; 3 types of weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb, as well as 3 types of steam, air, and gas separators. The booklet is completed with capacity tables, installation diagrams, and a section containing data, charts, and formulae for determining the proper size trap for specific applications. W. H. Nicholson.

Circle letter (BH) on reply card.

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(BI) SWIVEL-BAIL

National Supply has just released a bulletin giving the procedure for converting a conventional swivel-bail to the Ideal connector type swivel bail. Manufacturer says use of the improved bail provides fully articulated load equalization, saves time and effort in drilling operations and reduces maintenance costs. According to the bulletin the bail can be adapted for use with any elevator.

Circle letter (BI) on reply card.

(BJ) FACING ALLOYS

Colmonoy castings are discussed in a new folder published by Wall Colmonoy Corporation. Colmonoy is the general name given the hard facing alloys made by this company, developed to combat different types of wear: Abrasion, corrosion, impact, etc. Though castings of Colmonoy are mostly used where no wear-resistant material served before, they quite often replace the use of some other hard alloy, such as tungsten carbide, and at less cost. Diamonds and Tools Inc.

Circle letter (BJ) on reply card.

(BK) DISTRIBUTORS

Baroid Sales Division has published a booklet listing its distributors and the products carried. Also included are headquarters for more than 100 Baroid field engineers who render drilling mud service in oil fields of the United States and Canada. Distributors and sub-distributors in the U. S. and Canada are carried in alphabetical order according to states. National Lead Company.

Circle letter (BK) on reply card.

(BL) REVOLVER CRANES

A new catalog featuring American revolver cranes in industrial use has been released by American Hoist and Derrick Company. It's a pictorial catalog with views of the huge American revolver cranes working at ports and industrial plants throughout the world. It shows many specialized applications. Contents include short job stories as well as rated lifting capacities of the five standard models. American Hoist and Derrick Company.

Circle letter (BL) on reply card.

(BM) PIPE HANGERS

Blaw-Knox Company has published a valuable booklet containing 94 pages, covering pipe hangers, vibration eliminators, and supports. The spiral wire backed booklet contains various illustrations, diagrams, and tables on functional hangers, vibration eliminators, attachments to pipe, roller pipe supports, attachments to structures, and miscellaneous hanger parts. A technical section is included in the back containing information that would be necessary for a piping engineer to solve most hanger load problems. Included also in this section is a short discussion of, and a typical problem solved by the Flex-Anal Chart method for determing flexibility. Blaw-Knox Construction Company.

Circle letter (BM) on reply card.

(BN) STEEL TUBING

Assistance in solving problems involving the use of alternate grades of medium carbon, or full hardening, grades of tubing steels, is offered in a new four-page bulletin recently published. Known as Bulletin TDC 141, it presents condensed data on microstructure, critical points, effect of alloy elements, forging, machining, welding and thermal treatment for 14 well-known alloy steels used in the production of tubular parts. Babcock Wilcox Tube Company.

Circle letter (BN) on reply card.

(BO) "SHORTY" BLOCKS

IDECO, a division of Dresser Equipment Company, announces that a new bulletin describing the 65, 125, and 200-ton IDECO "Shorty" block is available. These blocks are short, compact assemblies which combine the traveling block spring loaded link adapter, and swivel bail hook. In addition the 200-ton model contains the new "hydraulic cushions." The bulletin presents photographs, construction details, and specifications. IDECO.

Circle letter (BO) on reply card.

(BP) DRAFT FANS

Prat-Daniel has published a new eight page illustrated bulletin, describing the design features of its forced draft fans. These fans employ oversized housings, deep inlet cones and, on double wheel models a split wheel design with a wide space between wheels, instead of the conventional common disc. This split wheel, fully explained in the booklet, provides four-way diffusion, increasing conversion of velocity pressure to static pressure. The Thermix Corporation.

Circle letter (BP) on reply card.

(BQ) DESULFURIZERS

Black, Sivalls and Bryson's latest bulletin discusses its new desulfurizer. The booklet gives information on the BS&B desulfurizer and the middle spread is a fold-over diagrammatic drawing of a complete desulfurizing hook-up. The desulfurizer consists of a sorber, still column, associated heat exchange equipment, reboiler, storage tank and pump. Black, Sivalls and Bryson, Inc.

Circle letter (BQ) on reply card.

(BR) GAS COMPRESSORS

A bulletin covering the new Clark HLA 7 in. by 19 in. gas engine driven compressor is now available. The new compressor delivers 250 bhp per power cylinder at 300 rpm, states the manufacturer, and many of the parts are interchangeable with the Clark HBA compressor. It is designed for 24-hour full load operation daily. The Clark HLA has oil-cooled piston and skirt. Clark Bros. Company, Inc.

Circle letter (BR) on reply card.

(BS) WIRE ROPE

A new, 112-page oil field handbook on wire rope, the first of its kind to include complete ton-mile tables for oil field drilling, is announced by Wickwire Spencer Steel Division of The Colorado Fuel and Iron Corporation. The new book makes available complete ton-mile tables for calculation of wire rope ton mileage without complicated figuring or computing. The ton-mile tables take up 50 pages and cover nine different sizes and weights of drill pipe in a range of excess weight from 15,000 to 60,000 lb. The new Wickwire Handbook also contains other valuable and factual information for all who are concerned with wire rope in the drilling of oil wells by both cable tool and rotary methods. Colorado Fuel and Iron Corporation.

Circle letter (BS) on reply card.

(BT) METERING FLOWS

Metering flows in crude oil or refinery products pipelines are covered in a new four-page bulletin which outlines the operating principles and application of the Brown electric flow meter system. The bulletin describes how differential pressure-type flow records are employed in the operation of pipe line pumping stations to assist in locating the source of a line pressure drop. Minneapolis-Honeywell.

Circle letter (BT) on reply card.

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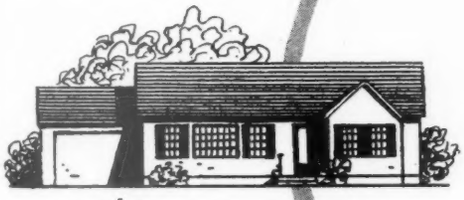

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BOOKS

Principles of Petroleum Geology, *by William L. Russell. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, N. Y. Price, $7. Pages, 492.*

A textbook and reference volume, this book gives a discussion of principles, methods, and techniques which are of importance in petroleum geology. Included in the list of subjects treated are: Origin and accumulation of oil, important structures, classification of fields, stratigraphic features such as reefs, geophysics, and the various well logging methods. Characteristics of oil and gas fields have been emphasized. Current advances in well-logging techniques and geophysics are covered, as well as special topics including gamma ray and neutron well logs and their recent improvements.

Economic Development Atlas, *by Victor Roterus and Sterling March. Published by U. S. Department of Commerce, Washington 25, D. C. Pages, 31.*

The purpose of this booklet is to portray the more significant economic changes that have taken place in the national economy over recent years. The growth of population from 1929-49, the distribution of that population, the changes in manufacturing, farming, and the increase in income payments are given. Each section is illustrated by a chart.

New Lessons in Arc Welding. *Published by The Lincoln Electric Company, Cleveland, Ohio. Price, $1. Pages, 312.*

This book is based on lessons and instructions given at the Lincoln Arc Welding School, covering fully basic fundamentals of arc welding as well as more advanced welding in alloys, sheet metal, and pipe. There are 32 basic lessons and 29 advanced lessons. Practice materials, exercises, questions and answers are given for each lesson.

The Tectonics of Middle North America, *by Philip B. King. Published by Princeton University Press, Princeton, New Jersey. Price, $3.75. Pages, 182.*

The regional geology of the United States and adjacent parts of Canada and Mexico, is described in this book. The tectonics of the rock formations of middle North America east of the Cordilleran system, how these formations were created, and their modification by subsequent unrest are included. Each section has a large bibliography of related material. Fifty-two maps and cross-sections illustrate the material.

Review of Current Research and Directory of Member Institutions, *published by the Engineering College Research Council, Georgia Institute of Technology, Atlanta, Georgia. Price $2.25. Pages, 250.*

More than 5200 engineering research projects, representing annual expenditures of over $50,000,000, are listed in this directory, which should serve as a useful guide to research activities in American engineering colleges and universities. Its listings of projects and personnel are complete as of March 1, 1951. A complete index of research projects subjects, including over 4000 entries, adds to the value of this book.

Helium Bearing Natural Gases of the United States, *by C. C. Anderson and H. H. Hinson. Published by Bureau of Mines. Bulletin 486. Price, 70 cents, Pages, 141.*

The results of a Bureau of Mines survey of helium resources are given in this report and comprise analyses and accompanying data on more than 2100 samples, which have been collected in 30 states. The survey to determine the nation's helium resources has been carried out in all natural gas producing areas of the United States since 1917. The primary purpose of this report is to make public the results of these surveys in tabulated form, as well as to present the historical background of the helium survey and describe methods of collecting gas samples and analyzing them. Detailed descriptions are given of the equipment and procedures used in making the analyses.

Subsurface Geology and Coal Resources of the Pennsylvanian System in Certain Counties in the Illinois Basin, *Report of Investigations No. 148. Published by Illinois States Geological Survey. Price, $1. Pages, 123.*

This volume contains the second series of reports that deal with the subsurface geology and coal resources of the Pennsylvanian strata in the various counties of the Illinois basin. The book is illustrated with 11 plates and contains 30 figures.

Loess Formations of the Mississippi Valley, Report of Investigations—No. 149, *by Morris M. Leighton and H. B. Willman. Published by Illinois State Geological Survey. Price, gratis. Pages, 27.*

Reprinted from the Journal of Geology, Nov. 1950, this booklet contains a survey of the occurrences of loess in the Mississippi River Basin. Here can be studied their stratigraphic succession, genetic relationships to source areas, distribution, modes of occurrence, topographic expression, and other matters that concern this Pleistocene deposit.

Adsorption, *by C. L. Mantell. Published by McGraw-Hill Book Company, 330 West 42nd Street, New York 18, N. Y. Price, $9. Pages, 605.*

Thoroughly revised, this second edition of "Adsorption" is considerably enlarged. Specifications, detailed testing, procedures, etc., have been completely revised, rearranged, and rewritten with cooperation of standardizing agencies and producers and users of adsorbent materials. New sections include: Fractionation by hydrocarbons, dehydration of liquids, refining of waxes, fractionation of ions, with particular reference to work of the Putonium Project, and adsorbents in medicine and pharmacy. Included are 133 tables and 263 illustrations.

Symposium On the Identification and Classification of Soils, *presented at the 53rd annual meeting, ASTM, June, 1950. Price, $1.65. Pages, 91.*

The intent of this symposium is to depict the most widely employed procedures in current use for identifying and classifying soils for engineering purposes. An appraisal of principles, a standard classification of soils, a discussion of soil classification for highway purposes are the general subject matter of the five papers contained in the report.

Illinois Mineral Industry in 1949, Report of Investigation —No. 150, *by Walter H. Voskuil. Published by Illinois State Geological Survey. Price, 25 cents. Pages, 6.*

This booklet contains a report of the statistics production of all minerals in Illinois for 1949. The report contains 14 illustrations and 50 tables.

Reference Book on Instruments for Electrolysis, Corrosion and Cathodic Protection, *published by the American Gas Association, 420 Lexington Avenue, New York 17, N. Y. Price, $1.50. Pages, 48.*

This reference book on corrosion instruments and equipment is offered as a collection of information relative to instruments and test equipment normally available and suitable for use in electrolysis, corrosion and cathodic protection testing. The book is divided into two main sections. The first is comprised of articles written with the intention of simplifying technical knowledge so that it will comply with the practical needs of the men in the field. The second section contains catalogue sheets and descriptive circulars, which have been supplied by instrument manufacturers.

Soil Testing for Engineers, *by T. William Lambe. Published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. Price, $5. Pages, 162.*

The primary purpose of this book is to fulfill a need for a textbook for teaching of soil testing. In addition to an introductory chapter on general laboratory practices, this book devotes a chapter to each of the tests presented. These include the kind of apparatus and supplies used, recommended procedures, discussion of procedure, calculations, results, and numerical examples. The book is well illustrated with photographs, charts, and formulas.

Viscosity and Plasticity, *by E. N. Da C. Andrade. Published by the Chemical Publishing Company, Inc., 212 Fifth Avenue, New York 10, N. Y. Price, $2.25. Pages, 84.*

Outlined in the three sections of this book are the phenomena of viscosity and plasticity. The subject is covered with a special view to those who deal with viscous and plastic material on an industrial scale. The first lecture discusses the nature and theories of liquid viscosity, aiming for an understanding of the complex behavior of flowing liquids and solids. The second lecture deals with the flow of simple liquids, suspensions, and gels. It also considers thixotropy, dilatancy, and other properties affecting flow. The flow of solids is the topic of lecture three. It covers sols and gels that can be poured slowly or with difficulty.

Science French Course, *by C. W. Paget Moffatt. Published by Chemical Publishing Company, 26 Court Street, Brooklyn 2, N. Y. Price, $4.75. Pages, 328.*

This book enables students without any previous knowledge of French to read French scientific and technical material and literature. It contains the necessary minimum of grammar, a large number of extracts carefully selected from recent scientific books and periodicals, covering as wide a field as possible, and an extensive vocabulary.